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# Real Overvaluation, Terms of Trade Shocks, and the Cost to Agriculture in Sub-Saharan Africa

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The observed decline of agriculture and the general worsening of economic conditions in Sub-Saharan Africa are linked to economic distortions, which limit growth.

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Policy Research

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Macroeconomic Adjustment and Growth

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This paper — a product of the Macroeconomic Adjustment and Growth Division, Country Economics Department — is part of a larger effort in the Department to study the linkages between agriculture and macroeconomic policy in Sub-Saharan Africa. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Victoria Barthelmes, room N11-025, extension 39175 (66 pages). January 1992.

Starting from the premise that agriculture should be pivotal in the structural transformation and economic development of Sub-Saharan Africa, Elbadawi addresses two related issues.

The first issue is the extent to which policy-induced distortions influence the structure of incentives for agriculture (with direct distortions induced by policies aimed directly at agriculture distinguished from indirect policies aimed at the economy's macroeconomic management).

The second issue is how these distortions affect agriculture's growth, given other growth fundamentals.

Preliminary analysis of evidence in Sub-Saharan Africa links the observed declines in agriculture and the general worsening of economic conditions to economic distortions. A more rigorous analysis, using data from the Sudan — an African country with a sizable agricultural economy — strongly supports the predictions of Easterly's endogenous growth model (1990), which posits the deleterious effects of economic distortions on growth.

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# 1. INTRODUCTION

> "While an agricultural-led growth strategy entails substantial risks, its success greatly reduces the most onerous risk humans face-the risk of dropping below the poverty line" John Mellor (1990).

Over the past few years, the case for agriculture as the engine of growth for the poor countries of the developing World, especially in Sub-Saharan Africa, has gained considerable support as lessons and evidence gained from past experiences and analytical and methodological advances started to influence our understanding of the process.[1] Citing past and recent evidence obtained from large sets of data from several developing countries, many authors (eg. T. Schultz, Kuznets, Mellor, Lal, and Johnston) have vigorously and persuasively argued for this particular strategy of economic development. This position is succinctly represented by the following three arguments advanced by Mellor (1990). First, because of its large initial size and the powerful stimulus it provides to the growth of other sectors, accelerated agricultural growth hastens decline in the relative size of agriculture by fostering more rapid growth in the nonagricultural sector. Second, concentration of public investment in agriculture tends to accelerate diversification within agriculture and in the rest of the economy. Third, agricultural growth by raising rural incomes and providing the opportunity to earn higher incomes, makes the farming of high-risk,low-income, and possibly environmentally unsustainable land unnecessary and undesirable.

Taking the above argument as a maintained position, this paper will attempt to address two inter-related issues critical to the role of agriculture in the context of economic development

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[1]Narain (1965), Krishna (1963), Behrman (1968), Schultz (1978), among others, provide some of the early evidence on the price responsiveness of the third world farmers. A more recent evidence on this as well as on the effects of agricultural technology on productivity and rural income is provided in Eicher and Staatz (1986) for example, in the context of the broader debate regarding the role of agriculture in economic development.

in Sub-Saharan Africa. The first issue is the extent to which policy[2] induced distortions influence the structure of incentives for agriculture in Sub-Saharan Africa; and second, the consequences for the growth of agriculture of these distortions given other relevant growth fundamentals.

In my view, these are important issues for the current debate on adjustment and growth in Sub-Saharan Africa because of the large evidence on the extent of government intervention in SSA both directly at the micro and sectoral levels as well as through indirect policies directed at the macroeconomic management of the economy. The above issues are also important in light of the recent findings in the endogenous growth literature which show that such policy induced distortions can have significant and deleterious effects on growth.

Economic distortions may be emanating from micro and sectoral policy interventions directly deployed on agriculture. This direct set of distortions should be distinguished from distortions that influence the sector indirectly and are induced by policy directed at the macroeconomic management of the economy. Direct distortions are both relatively easier to measure and their impact on agriculture is well understood. It is now a generally accepted proposition that economy wide distortions, such as the overvaluation of the real exchange rate, can have deleterious effects on tradable sectors of the economy such as agriculture. An assessment of real exchange rate overvaluation can be problematic, however, since it must be measured relative to its unknown equilibrium. The concept of 'Equilibrium RER' is, therefore, critical to this analysis and hence modelling and estimation of this 'unobserved' index will be emphasized in this paper.

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[2] These are policies that either directly or indirectly affect relative prices and resource allocation - such as tariffs and import quotas, controls on prices and interest rates, taxes, and expansive fiscal and monetary policy.

Contrary to the predictions of the standard neoclassical growth models[3], empirical evidence have shown that growth is significantly related to economic distortions (e.g. Easterly and Wetzel (1989)).[4] Formal models of endogenous growth[5] solve for the rate of growth as dependent (negatively) on economic distortions along with other more conventional growth fundamentals such as the stocks of physical and human capital. The model predicts that small changes in distortions do not affect growth much if the initial conditions are ones of very high or very low distortions, but have a strong effect in between those extremes. Optimal saving behavior would make growth sensitive even to low distortions, however, Easterly (1990). Using data from the Sudan - an SSA country with a sizable agricultural economy, we test the implications of the endogenous growth model in this paper. Other factors relevant to economic growth in SSA that are also considered in the empirical model of this paper are the impacts on agricultural growth of exogenous worsening of terms of trade and import compression induced declines in capacity utilization, Ndulu (1990). These two factors which reflect the potential impact on economic performance in SSA of unfavorable external environment, provide some balance to the mainly 'internalistic' view of the causes of economic crisis which centered around domestic policy-induced real overvaluation.[6]

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[3]Given the existence of non-reproducible factors, constant returns to scale, and diminishing returns to each factor, steady-state growth-as predicted by these models - can only take place through exogenous technological change.

[4]Also these models fail to explain the observed nonconverging per capita income growth rates across regions (Easterly (1990)).

[5]e.g. Easterly (1990) which also contains a list of recent works in this literature.

[6]For a discussion of the "internalist versus externalist" interpretation of the source of economic crisis in Africa see Mkandawire (1989) and references cited therein.

## 1.1 Government Intervention and Agriculture in Sub-Saharan Africa: An Overview

Governments' interventions in agriculture are wide spread and common to all countries developed as well as less developed alike. SSA has not been an exception as can be seen from the record of agricultural sector pricing policy in table (1.1) below. This form of intervention is explicit and operates along the supply curve and is executed through the instruments of forced procurement, administered pricing, export and local taxation, among others. The practical motivation for such practice on the part of governments could be to raise revenue or to keep down the prices of food.[7] Such squeeze on agriculture is argued to be a main cause of rural poverty[8], and a major obstacle preventing agriculture from accelerating the process of growth and structural transformation.[9]

The potential deleterious impact on agriculture of the above direct form of government policy, may be reversed, however, by another set of direct interventions which tend to shift the agricultural supply curve. In this case government interventions through the 'shifters of supply' such as agricultural technology, credit, investment, and price stabilization schemes are helpful to agriculture. Indeed in the case of the countries of SSA such role for government is critical for the development of a viable agriculture. Micro and institutional considerations aside, the ability of governments in SSA to undertake such a role depends critically on the prevailing international economic environment and domestic macroeconomic conditions. For example after 1982 a

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[7]There is now a vast body of literature on the underlining political economy of these policies. An interesting analysis for the case of African agriculture is provided in Bates (1981,82), and Commins, Loftchies, and Payne (1986).

[8]Garcia (1981), for example, found agriculture prices to be a major determinants of rural wages.

[9]The arguments regarding the implications of such sector-specific policies for the growth of agriculture are well understood and has occupied a central position in the literature. e.g. Eicher and Staatz (1986) and the literature cited therein.

combination of worsening terms of trade, reduced concessional foreign aid, and the required need for adjustment led to a further squeeze on investment (see table 1.2)).

More recently it is becoming widely accepted that the structure of incentives facing agriculture is influenced, as well, by indirect interventions in the form of exchange rate, foreign trade, and other macroeconomic policies. The impact on agriculture, of these policies is 'implicit' or 'indirect' and it operates through the real exchange rate.[10] Given the high degree of tradability in agriculture, policies that lead to real overvaluation will create a structure of incentives biased against agriculture vis-a-vis other sectors in the economy, especially the non-traded service sector. The evidence in the literature suggest that these implicit policy induced effects can be quite strong, in fact they can be so strong to overwhelm possibly favorable direct sector-specific agricultural price policies and other direct forms of interventions (e.g. Krueger, Schiff, and Valdés (1988)).

The average performance of the economies of SSA has worsened over the last two decades, and by the turn of the 1980's decade economic conditions in the continent assumed crisis proportions. Real GDP growth rate declined from an annual average of 3.7% in 1970-81 to only 1.4% for 1982-85. With the high and steady rate of population growth in Africa, this translated into substantial declines in the standard of living with per capita income declining at an average rate of 0.9% in 1970-81 and 2.5% in the following period 1982-85. Other concomitant aspects of Africa's economic crisis are reflected by the sharp declines in foreign sector indicators. Thus, between the above two sub-periods the average rate of growth of exports declined from 3.6% per annum to 1.1%. The worsening export performance is closely related to the declining share of

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[10]This strand of the literature is an outgrowth of the Dornbusch (1974) two sectors model of tradables and nontradables. This model was subsequently extended by Sajaastad (1980) to a three sector model of importables, exportables, and home goods. Applications of this model to agriculture include Valdés (1985,86), Mundlak, Cavallo and Domench (1987), Garcia (1981), Bautista (1985), Elbadawi (1987), Oyejide (1986,87) and Tshibaka (1986), to mention a few.

agriculture in the domestic economies of SSA and the expansion of the nontraded service sector between the two periods (see table (1.3)). Similarly, the average ratio of external debt service to exports increased sharply from an average of 9.6% in 1973-81 to average 16.7% for the 1982-85 period (table (1.2)), the stock of external debt to GDP ratio also rose from 39% in 1980 to 69% in 1987. In short the story of economic performance in Africa is summed up by Oyejide (1990), "There is very little debate regarding Africa's poor economic performance and the Long-term nature of the decline in living standards, particularly during the 1980's. But controversy continues to surround the issue of which factors are responsible for the crisis."

One important interpretation of the causes behind the declining shares of agriculture and the general worsening positions of the economies of SSA as described above, emphasizes the role of domestic economic policies, especially real appreciation and real overvaluation.[11] The evidence from Sub-Saharan Africa (see table (1.2)) points to episodes of dramatic real appreciation over the seventies and the first half of the 80s. The real appreciation is clearly related to the high rate of fiscal expansion and the increased domestic absorption (negative of the resource balance) where both indicators respectively rose by 2.1 and 1.4 percentage points of GDP between the first two periods (table (1.2)). On the face of this expansive macroeconomic policies, SSA experienced severe negative external shock, where the value of this aggregate shock turned from a small but positive average of 0.1 to a negative at -5.3. The terms of trade component of this shock also reflect the same effect, with the TOT index declining from 106.3 in 1973-81 to 91.6 in 1982-85. Also external finance available to SSA dropped by more than 50% over the two periods. Therefore, as the RER is appreciated, the major fundamentals call for an equilibrium depreciation of the RER. Hence, it is likely that the economy wide-structure of

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[11]A frequently cited analysis of the economic crisis of SSA representing this tradition is the World Bank's Berg Report (World Bank (1981)).

incentives has been unfavorable for agriculture in most of the economies of SSA during the period considered. Another evidence in support of this view is the tremendous expansion of parallel markets in SSA and the rising black market exchange rate premium which is directly related to real overvaluation and economic distortions in general (table (1.2)).[12]

Another possible explanation of Africa's economic performance emphasizes the exogeniety of the determinants of economic growth in Africa, especially the effect due to the observed sustained worsening TOT for SSA and the declining external finance available to it. Regardless of the extent of domestic policy accommodation to external shocks, "The results of these unfavorable TOT have been increased indebtedness which, in its turn, has given birth to crippling debt repayments that are starving all sectors of the economy of the essential imported inputs. Faced with limited resources, African governments have reduced investments in infrastructure and in most cases even existing infrastructure is in disrepair for lack of necessary inputs for maintenance. This further contributes to the structural rigidities that blunt supply responsiveness of African agriculture," Mkandawire (1990). Also Ndulu (1990) found strong evidence in support of the exogeniety of growth thesis in the context of SSA.[13] Cross sectional evidence from SSA suggests that while negative external shock has been the trigger factor that led to economic decline in SSA; it does not, however, explain economic performance in isolation of initial conditions or policy stance, nor does it explain variations in economic performances across countries in SSA. (Elbadawi (1991)).

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[12]Using an econometric model, Ghura and Grennes (1991) estimated RER misalignment in SSA in excess of 28% per annum over the (1972-87) period.

[13]The official African view at the time also emphasized the role of external factors such as world recession, falling commodity price, rising interest rates and debt burden, as well as drought, as the major factors responsible for Africa's economic crisis (Lagos Plan of Action (1980), O.A.U).

In actuality both exogenous external shocks and domestic policy mistakes have been at work to undermine economic performance in SSA over the past two decades. Also it "should be noted, of course, that African governments acknowledge that poor domestic policies in the early 1980's have played a role in the economic crises. In the same way, external commentators certainly acknowledge the impact of external and climatic constraints on the economies of SSA countries," Oyejide (1990). At any rate, with regard to our specific interest in this paper concerning the structural shifts in the economies of SSA and the role of agriculture, it is clear that both of the above two approaches necessarily rule out any possibility that such change in the structure of the African economies could have been brought by the diversification effects of a growing agriculture at the initial stage of economic development.

Faced with severe macroeconomic problems such as falling export earnings, worsening balance of payments, mounting debts, and declining economic growth; many African countries undertook economic reform programs, almost all of them assisted by multilateral and bilateral donors. In 1979 the World Bank for example, introduced the concept of structural adjustment lending (SAL) in order to help countries experiencing difficulties in adopting to external shocks, to phase out the initial cost of the stabilization part of adjustment while implementing appropriate policy and institutional reforms aimed at making the economy more flexible and strengthening its capacity for adjusting relatively more efficiently and easily to future shocks (World Bank (1985)).

The participation on the SALs programs on the part of the countries of SSA over the 1980s has been quite substantial.[14] The SALs and SECALs policy prescriptions strongly emphasize the adoption of outward-oriented development strategy, specially export expansion as

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[14]By FY 1988, the share of SALs and the broadly similar Sectoral Adjustment Loans (SECALs) in Bank lending was almost 25%. Between 1979 and 1987, some 25 SSA countries received World Bank adjustment loans almost half of total SAL and SECAL lending (Oyejide (1990), table (2)).

the primary channel for eliminating the balance of payments and debt problems. Considerable and recurrent nominal devaluations, macroeconomic retrenchment, and foreign trade and institutional reforms were the main vehicles for eliminating real overvaluation and creating a structure of incentives consistent with this strategy. Given the intensity and the nature of these reforms, in addition to the dominant role of the highly tradable agricultural sector in the economies of SSA, agriculture became the main focus of these programs an the success of the later depended heavily on the supply response of agriculture.

As can be seen from table (1.2), some real depreciation has been achieved over 1986-89.[15] Also the deteriorating performance of agriculture have been reversed.[16] This however, does not imply that this improvement can be solely or even mostly attributed to improved structure of incentives for agriculture, since other nonprogram factors such as the weather conditions may have influenced the outcome. Even if the structure of incentives was sufficiently favorable to agriculture, the supply response may be blunted by other components of the program, especially the cut in government expenditure and import compression. The observed decline in investment and import ratios over the reform period (table (1.2)) can reduce both capacity growth as well as capacity utilization[17] in the economy.

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[15]1986-89 is argued to be the appropriate period to assess the effect of structural adjustment programs on economic performance (see World Bank (1990)).

[16]Total agricultural production grew at an average rate of 4% per annum during 1984-88 (FAO, 1989). Also per capita agricultural output recovered from earlier declines and was rising or stable between 1985 and 1988.

[17]This is because imported intermediate goods are imperfect substitutes to domestically produced goods in most of the economies of SSA (Ndulu (1990)).

Table (1.1)

Average Ratios of Producers Prices to Border Prices for selected African countries (converted at nominal exchange rates), 1970-86.

| | 1970-81 | 1982-86 |
|---|---|---|
| KENYA | | |
| Smallholder coffee | 0.93 | 0.84 |
| Smallholder tea | 0.64 | 0.73 |
| MALAWI | | |
| Smallholder Dark-fired | 0.23 | 0.23 |
| Estate Burley | 0.51 | 0.36 |
| Estate Flue-cured | 0.67 | 0.41 |
| TANZANIA | | |
| Smallholder tobacco | 0.42 | 0.33 |
| Smallholder cotton | 0.51 | 0.85 |
| Smallholder coffee | 0.41 | 0.46 |
| CAMEROON | | |
| Arabica Coffee | 0.52 | 0.37 |
| Robusta Coffee | 0.44 | 0.38 |
| Cocoa | 0.44 | 0.46 |
| Cotton | 0.48 | 0.73 |
| NIGERIA | | |
| Cotton | 0.70 | 0.90 |
| Palm Kernel | 0.79 | 1.27 |
| SENEGAL | | |
| Groundnuts | 0.32 | 0.52 |
| Cotton | 0.13 | 0.15 |

Source: Computed from Uma Lele (1990) Tables (12) and (14).

Table (1.2)
Selected Macroeconomic Indicators for Sub-Saharan Africa

| INDICATOR | 1973-81 | 1982-85 | 1986-89 |
|---|---|---|---|
| Investment to GDP ratio | 21.5 | 18.7 | 17.1 |
| Domestic Savings to GDP ratio | 13.0 | 8.8 | 9.1 |
| Resource Balance to GDP ratio | -8.3 | -9.7 | -8.0 |
| Imports to GDP ratio | 37.2 | 37.0 | 34.5 |
| Debt Service to Exports ratio | 9.6 | 18.4 | 26.4 |
| REER (1980=100) 1/ | 95.5 | 113.5 | 89.4 |
| Terms of Trade Index | 106.3 | 91.6 | 80.8 |
| Rate of change of CPI (inflation) | 16.5 | 17.7 | 20.5 |
| Black market exchange rate premium (%) 2/ | 128.9 | 221.9 | 90.9 |
| Fiscal Deficit to GDP ratio | 5.3 | 7.4 | 7.8 |
| External Shock 3/ | 0.1 | -5.3 | -2.2 |
| External Financing (net flows in 1980 US$mn) | | | |
| Total 4/ | 7830 (29%) | 3839 (-28%) | 4635 (25%) |
| Public | 7136 (28%) | 3357 (-30%) | 4272 (31%) |
| Private | 694 (55%) | 482 (-13%) | 363 (.03%) |

Notes: 1/ Index of the period average exchange rate of the currency to a weighted geometric average of exchange rates for the currencies of selected partner countries and adjusted for relative price movements in national price of the home country and its partners. An increase in the index reflects an appreciation.

2/ Includes only Ethiopia, Ghana, Kenya, Malawi, Sudan, Tanzania, Zaire and Zambia.

3/ The total effect of external shocks as % of GDP is computed as the sum of the real interest rate effect and the terms of trade effect. The interest rate effect is calculated as -(r-rbase)*(debt/GDP)beg, where r is the real interest rate computed as (i-dp/p)/(1+dp/p); rbase is the average real interest rate of base period; it is the ratio of interest payments to total debt; interest payments are calculated by adding public interest payments to private interest payments; private interest payments are proxied by multiplying private debt by L (L equals three-month annualized LIBOR plus one percent); the private debt is estimated by subtracting public and publicly guaranteed debt from total debt; dp/p is "world" inflation (proxied by the percentage change of the GNP deflator of the US), and (debt/GDP)beg is the ratio of debt to GDP of the year preceding the beginning the end period. Debt data correspond to total disbursed guaranteed and non guaranteed debt. The effect of terms of trade is computed as [((PX/PXbase)-1)*(X/GDP)beg]-[((PM/PMbase)-1)*(M/GDP)beg], where PX and PM are the average export and import price indices deflated by US GNP deflator, respectively; PXbase and PMbase are the average price indices of the base period; X and M are exports of GNFS and imports of GNFS respectively; and (X/GDP)beg and (M/GDP)beg are the ratios of X and M to GDP respectively at the year preceding the begining of the end period. All the variables are denominated in current US dollars.

4/ The periods used are 1970-1980, 1983-1985 and 1986-1989 respectively. The figures in parentheses refer to average annual growth rates.

Source: World Bank (BESD), OECD 1990 Report, Pick's Currency Yearbooks.

Table (1.3)
Economic Structure and Performance in Sub-Saharan Africa

| | 1970-81 | 1982-85 | 1986-89 |
|---|---|---|---|
| Real growth rates | | | |
| GDP | 3.7 | 1.4 | 2.0 |
| Exports | 3.6 | 1.1 | 3.3 |
| Share in GDP | | | |
| Agriculture | 39.3 | 36.7 | 36.3 |
| Manufacturing | 20.1 | 22.0 | 21.7 |
| Services | 37.9 | 41.3 | 41.2 |
| Share in Labor Force | | | |
| Agriculture | 78.5 | .. | .. |
| Manufacturing | 7.8 | .. | .. |
| Services | 13.7 | .. | .. |
| Rural population (% of total population) | 79.6 | 74.4 | 71.2 |

Source: World Bank Data Bank (BESD)

## 2. THE EQUILIBRIUM RER AND ITS DETERMINANTS

Measuring the degree of misalignment is difficult, since it requires measuring an unobserved variable, the "equilibrium" real exchange rate. An common approach is based on the purchasing power parity doctrine: a base period is chosen in which the economy is thought to be in equilibrium, and then the real exchange rate for this year is dubbed the equilibrium for the remainder of the sample period. A fundamental problem with this, however, is that economic theory tells us that the real exchange rate moves over time in an economy in equilibrium. The PPP approach therefore runs the risk of identifying as a misalignment what may in fact be an equilibrium movement in the real exchange rate.

We follow Edwards (1989) in defining the "equilibrium real exchange rate" (ERER) as "the relative price of tradables to nontradables which, for given sustainable values of other relevant variables such as taxes, international terms of trade, commercial policy, capital and aid flows and technology, results in the simultaneous attainment of internal and external equilibrium", (Edwards (1989), pp. 16). Internal equilibrium is achieved when the market for nontradable goods clears in the present and is expected to clear in the future; external equilibrium holds when present and future current account balances are compatible with long-run sustainable capital flows.

As pointed out by Edwards, this definition of the ERER differs from the traditional PPP definition in treating the ERER as a function of other real variables (the "fundamentals") rather than as a fixed number. Furthermore, since the above notion of equilibrium is necessarily intertemporal in nature, the path of the ERER will not only be affected by the current values of the fundamentals, but also by anticipations regarding the future evolution of these variables.[18]

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[18]Edwards (1986b) and chapter 2 of Edwards (1989) formalizes this concept of ERER in the context of an intertemporal optimizing model; see also Lizondo (1989).

The ERER therefore experiences movements in response to exogenous and policy-induced shifts in its real fundamentals. In addition to such movements, however, the observed RER is also influenced in the short to medium run by macroeconomic and exchange rate policies that are not part of the fundamentals. RER misalignments can occur (as in the standard PPP theory) when those policies are inconsistent with the fundamentals. In a system of pegged nominal exchange rates, expansionary fiscal and monetary policy can be a cause of persistent real overvaluation; Edwards (1989) and Elbadawi (1989) provide strong empirical evidence on this. The remainder of this section is devoted to formulating a simple and parsimonious real exchange rate model. As indicated above, a successful modelling strategy should have at least three elements:

(i) it should specify the ERER as a forward-looking function of the fundamentals;

(ii) it should allow for flexible dynamic adjustment of the RER toward the ERER, and

(iii) it should allow for the influence of short to medium run macroeconomic policy on RER.

## 2.1 The Model

The RER model accounts for the traditional long run real determinants such as the terms of trade and commercial policy. The model also incorporates the effect of domestic absorption which reflects the impact of excess aggregate demand in the economy. Another attractive aspect of this model is that it explicitly considers the impact on RER when conditions of excess domestic demand for foreign exchange under currency inconvertibility give rise to the emergence of a black market for foreign exchange where domestic residents can acquire foreign currency at a premium rate; and where a large number of imports are transacted according to this depreciated rate while most of exports, mainly agricultural or mineral in SSA, were required to be surrendered at the officially sanctioned rate.

Let the (dollar) denominated international price of exportables and importables be given by $P_x^*$ and $P_m^*$ respectively. By invoking the small country assumption, $P_x^*$ and $P_m^*$ can be considered as exogenous variables. Therefore for a given set of exchange rate and commercial policy, $P_x$ and $P_m$ the domestic prices of exportables and importables will be determined respectively by $P_x^*$ and $P_m^*$ . Let $E_0$ and $E_b$ be respectively the official and the black market rates of exchange where the exchange rate is given in terms of units of domestic currency per unit of the foreign currency (dollar). Also let $t_x$ be the net export tax rate, and $t_m$ be the net tax rate on imports which may also include non-tariff implicit taxes such as quota rationing. The domestic price of exportables and importables can then be defined as in equation (2.1) and (2.2) below:

$$(2.1) \qquad P_x = E_0(1-t_x)P_x^*$$

$$(2.2) \qquad P_m = E_0^a E^{1-a}.(1+t_m)P_m^*, 0<a<1$$

The presence of the black market rate in equation (2.2) reflects the increasing reliance on the black market dollars to finance some key import categories in many LDCs and Sub-Sahara African countries in particular.

Given our interest in assessing the impact of RER overvaluation for agriculture, we adopt the following definition of RER which is a simple version of the dependent economy type (see Dornbusch (1974, 1980) for example). Letting $P_N$ stand for the price of nontradables, and e for RER, we have:

$$(2.3) \qquad e = E_0/P_N$$

Consider now the equilibrium in the nontraded goods market. Equilibrium in the current period requires that excess supply of nontraded goods be zero:

$$S_N(P_x, P_m, P_N).Y - D_N(P_x, P_m, P_N).A_p - G_N = 0$$

where Y is nominal GDP, $A_p$ is nominal private domestic absorption, and $G_N$ is nominal government expenditure on nontraded goods. Since $S_N$ and $D_N$ are homogenous in prices, we can write the above as follows:

$$(2.4)\quad d_N\left(\underset{(+)}{\frac{Px}{PN}}, \underset{(+)}{\frac{Pm}{Px}\cdot\frac{Px}{PN}}\right).\left(\frac{A_p}{Y}\right) + \left(\frac{G_N}{Y}\right) - S_N\left(\underset{(-)}{\frac{Px}{PN}}, \underset{(-)}{\frac{Pm}{Px}\cdot\frac{Px}{PN}}\right) = 0$$

Using (2.1) - (2.3) into (2.4) and log linearizing, we can solve the market-clearing conditions for the ERER as a function of foreign prices, foreign trade taxes, the black market premium $\left(q=\frac{Eb}{Eo}\right)$, real private absorption and real government expenditure on nontradables.

$$(2.5)\quad \log e_t = \lambda_0 - (1-\lambda_1)\log P_{x_t}^* - \lambda_1 \log P_m^* - (1-\lambda_1)\log(1-t_x)_t$$

$$-\lambda_1\log(1+t_m)_t - \lambda_1(1-a)\log q_t - \lambda_2 \log\left(\frac{A_p}{Y}\right)_t - \lambda_3\log\left(\frac{G_N}{Y}\right)_t$$

The above equation produces the conventional effects on RER in a similar fashion to other models in the literature[19],[20]. For example a restrictive foreign trade system sustained for a long

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[19]The empirically-oriented literature in this tradition includes Edwards (1989, 1986c), Elbadawi (1989), Mundlak, Cavallo and Domenech (1987), Krueger, Schiff, and Valdés (1988), and Valdés (1985), to mention a few examples.

[20]This model, however, differs with the above cited literature in that it provides for more general interpretation of the TOT effect (see the above discussion).

period is predicted to generate a lower ERER (or a lower RER is consistent with balance in nontraded goods markets the more restrictive the foreign trade regime). Also the same effect on RER obtains for a higher level of domestic absorption relative to GDP as reflected by the negative coefficients on $(\frac{A_p}{Y})$ *and* $(\frac{G_N}{Y})$. For the particular definition of RER adopted in this paper, a rise in the premium (logq) will lead to real appreciation and the extent of this appreciation depends on the elasticity of the price of importables in the home goods market, as well as the share of imports financed through the black market, 1-a. Finally the effect of foreign prices on RER is such that a TOT deterioration brought about by a decline in the foreign price of exports leads to RER depreciation while it leads to RER appreciation if it were caused by an increase in the foreign price of imports. As shown by Rohdos (1990), even though there is abroad empirical support for the commonly held view that a TOT deterioration causes an RER depreciation as the fall in real income reduces the demand for nontradable goods and consequently its relative price (e.g. Dornbush (1980), and Neary (1988)); nevertheless there exists asymmetries in both temporal and intertemporal substitution effects that many be quite relevant we well.[21]

The ultimate reduced form for RER is obtained by endogenizing the premium by solving for the stationary level of the premium that satisfies equilibriums in the asset markets and the flow current account balance. A General expression for such solution is provided in equation (2.6) below (see Elabdawi (1990) for a complete specification).

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[21]In fact both of the two last authors acknowledged that in the case of a rise in the price of imports, income and substitution effects work in opposite directions, whereas they reinforce each other in the case of a fall in the price of exports.

$$(2.6) \quad q = q\ (e,\ \frac{A_P}{Y}, \frac{G_N}{Y},\ 1-tx,\ \ 1+tm)$$
$$(-)\ (+)\ (+)\ \ (+)\ \ \ (+)$$

Equation (2.6) allows us to eliminate q from (2.5) to have the following unrestricted expression for RER:

$$(2.7) \quad \log e_t = \alpha_0 - \alpha_1 \log P^*_{x_t} - \alpha_2 \log P^*_{m_t} - \alpha_3 \log(1-t_x)_t$$
$$- \alpha_4 \log(1+t_m)_t - \alpha_5 \log(\frac{A_P}{Y})_t - \alpha_6 \log(\frac{G_N}{Y})_t$$

Equation (2.7) is assumed to hold at present and in the future for sustainable values of its arguments. The equation by itself is not adequate for RER determination, however, since $A_P$ is endogenous (and potentially Y and $G_N$ as well). To complete the model, we endogenize $A_P$ by specifying an equation linking private absorption to the sustainable level of net capital inflows NKI (i.e., to the sustainable current account deficit) and to the real consumption rate of interest:

$$(2.8) \quad \frac{A_P}{Y} = a_p(\frac{NKI}{Y},\ r^* + \sigma \cdot [{}_t\log(e_{t+1}) - \log(e_t)])$$
$$(+) \qquad\qquad (-)$$

where r* is the world interest rate, $\sigma$ is the share of nontraded goods in consumption, and the notation ${}_tX_{t+j}$ means the expectation of $X_{t+j}$ at time t. A rise in sustainable capital inflows allows a higher sustainable level of absorption; a rise in the real interest rate, either through a rise in r* or through a rise in the expected rate of real depreciation relative to the current, increases the demand for saving and thus reduces absorption relative to income.

Abstracting from r* we rewrite (2.8) above in the following linearlized form:

$$(2.9)\quad \log\left(\frac{A_P}{Y}\right)_t = \beta_O + \beta_1\left(\frac{NKI}{Y}\right)_t - \beta_2(\log e_{t+1} - \log e_t)$$

Solving (2.7) and (2.9) together yields the following reduced-form dynamic equation for the real exchange rate:

$$(2.10)\quad \log e_t - \lambda_t \log e_{t+1} = \delta_0 - \delta_1 \log P^*_{x_t} - \delta_2 \log P^*_{m_t} - \delta_3 \log(1-t_x)_t$$

$$- \delta_4 \log(1+t_m)_t - \delta_5\left(\frac{NKI}{Y}\right)_t - \delta_2 \log\left(\frac{G_N}{Y}\right)_t$$

where $\lambda = \alpha_4\beta_2/(1+\alpha_4\beta_2)<1$, and where the $\delta$'s are the corresponding coefficients on the right hand side.

The equilibrium real exchange rate, $\bar{e}$, is that value of the RER that satisfies equation (2.10) for sustainable values of the right-hand side variables.[22] Equation (2.10) can be solved forward for $\log(\bar{e}_t)$ by recursive substitution. Imposing the no-bubbles solution, and defining the parameter vector $\delta$ by $\delta = (\delta_0, -\delta_1, -\delta_2..., -\delta_6)'$ and the vector of fundamentals F by

$$F' \equiv \left(1, \log P^*_x, \log P^*_m, \log(1-t_x), \log(1+t_m), \log\left(\frac{Ap}{Y}\right), \log\left(\frac{G_N}{Y}\right)\right)$$

we get the following forward-looking expression $\bar{e}$ for given sustainable values of the fundamentals vector (we denote sustainable values of F by $\tilde{F}$):

$$(2.11)\quad \log \bar{e}_t = \sum_{j=0}^{\infty} \lambda^j \delta_t' \tilde{F}_{t+j}$$

It can be shown that if $\tilde{F}$ are stationary in first differences (ie I(1)) then the following cointegration

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[22]Notice that the ERER is not unique, since it is a function of policy fundamentals as well as external fundamentals.

relationship exists (e.g. Kaminsky (1988)).

$$(2.12) \quad \log\tilde{e}_t = \frac{1}{1-\lambda}\delta' \tilde{F}_t + \eta_t$$

where $\frac{1}{1-\lambda}\delta$ is the cointegration vector and $\eta$ is a stationary disturbance term.

## 2.2 An Error-Correction Equation for the RER

If the cointegration relationship in equation (2.12) above is valid, then equation (2.12) cannot only be interpreted as a long-run equilibrium but it is also consistent with a dynamic error-correction specification (Engle and Granger (1987)). The error-correction equation consistent with the (assumed) cointegration equation in (2.12) is given in (2.13) below:

$$(2.13) \quad \Delta\log e_{t+1} = b_0\left(\frac{1}{1-\lambda}\delta' F_t - \log e_t\right) + b_1'\Delta F_{t+1} + b_2\Delta\log E_{0_{t+1}} + \epsilon_{t+1}$$

Where the disturbance $\epsilon_{t+1}$ is a stationary random variable composed of the one-step-ahead forecast error in the RER ($\Delta\log e_{t+1} - {}_t\Delta\log e_{t+1}$).

The error-correction term in equation (2.13) clearly incorporates the forward-looking sources of RER dynamics. Suppose, for example, that we start from an initial condition of real overvaluation i.e. the error-correction term is positive; now if the expected change in the fundamentals calls for equilibrium real depreciation in the future, the self-correcting mechanism that leads to future depreciation in the actual RER will be set in motion. This effect is captured by the positive error-correction term and its positive relationship with $\Delta\log e_{t+1}$.

The adjustment speed depends on the parameter $b_0$, which falls in the interval (0,1). A value of $b_0$ equal to one signifies prompt adjustment over just one period, while the smaller the value of $b_0$, the slower the adjustment will be. In addition to the equilibrium long-run impact of the fundamentals, which is captured by the cointegration vector $\frac{1}{1-\lambda}\delta$, temporary changes in the fundamentals may also have short-run effects which are captured by the vector $b_1$. This later effect may also reflect the effects of macroeconomic policy shocks on the RER; these are captured by the negative coefficients due to $(\frac{NKI}{Y})$ and $\log(\frac{G_N}{Y})$. Finally, the short-run impact effect of nominal depreciation is given by the coefficient $b_2$. As pointed out by Edwards (1989) a nominal devaluation will help the adjustment process only to the extent that the initial situation is one of overvaluation, and only if the nominal exchange rate adjustment is accompanied by supporting macroeconomic policy.

## 3 . AN EMPIRICAL REAL EXCHANGE RATE MODEL FOR THE SUDAN

In this section we will apply the above RER model to analyze the determinants of the Sudanese RER. The Sudan economy provides an interesting case study to discuss the type of issues considered in the above model. The mainstay of the Sudan economy is provided by its agricultural sector which provides for more than 90% of total foreign exchange earnings out of exports, over 35% of GDP, and about 44% of total employment (see table (3.1)). The domestic industry and a significant portion of the agricultural sector, on the other hand, depend heavily on imported capital and intermediate goods. Despite an increasing share for the nontradable service sector in the GDP, the Sudanese economy remains highly tradable with combined share of agriculture and industry in GDP in excess of 50% (see table (3.2)).

Given the high tradability of agriculture in Sub-Saharan Africa, and especially in Sudan, the RER is likely to have a significant effect on the sector. A view of the Sudan's RER and its potential determinants is provided by Tables (3.3) and (3.4). One such determinant is TOT which has been pursuing a rising trend except for the year 1975 and the period 1979-82 which came immediately after two major oil price hikes. The Sudan's economy has also been characterized by an extensive system of import restrictions and fixed multiple exchange rates. This type of regime which is generally considered typical of most LDCs, is presumed to have its intellectual motivation in a development doctrine bent on "Industrial Import Substitution" as the main strategy. In the case of the Sudan, however, other goals such as balance of payments, and government revenue considerations, encouragement of remittances from Sudanese nationals working abroad (SNWA) and to some extent export promotion, seem to be the key factors shaping the Sudan's foreign trade and payment regime Elbadawi (1987). As the Sudanese economy started to assume crisis proportions by the mid seventies, and the domestic and foreign balances continued to worsen; the need to check excess aggregate demand and to maintain government revenues ensures the maintenance of the above

system. The attempted foreign trade liberalization that came with the IMF-inspired package of 1979 could not therefore, be sustained. The figures on table (3.3) attest to the above description.

Also, as can be seen from Table (3.4), the turbulent development in the Sudanese macroeconomic scene after the mid seventies have included massive monetary expansion with the money supply ($M_1$) and domestic credit growing, respectively, at an average annual rate of 27%, and 26% during 1975 - 1986. The official reserves which have been stagnant or at times growing at a negative rate have only partially moderated the overall growth rate in the money supply. The combination of monetary expansion and highly anticipated maxi-devaluations has accelerated domestic inflation which rose from a single digit at 1972/73 to more than 38% by 1985. Such conditions of inflationary environment and highly suppressed aggregate demand, especially the one for imported goods, have paved the way for the emergence and subsequent expansion of the black market for foreign exchange. In recognition of the increasing importance of SNWA remittances as a source of much needed foreign exchange[23], the authorities have introduced a premium exchange rate for SNWA remittances and a new import system the 'nil-value' system. These two measures were designed to encourage the transfers of remittances through regular banking system and the use of SNWA savings to finance imports to the country. The official exchange rate, however; could not keep pace with the black market rate, see table (3.3); and therefore the lion share of SNWA remittances were channeled through the black market. On the other hand, the 'nil-value' system of imports - being largely financed by black market dollars - were turned into a current account link for the black market. For example by 1980 about 60% of total imports were financed through the black market, Hussein (1986). Due to the existence of such a large black market for foreign exchange, the black market premium can be an important indicator of official RER overvaluation.

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[23]For example the size of total SNWA remittances is estimated to average $1.6 billion per annum for the 1980/81 to 1988/89 period (see table (2) of Elbadawi (1990)).

3.1 The Econometric Estimation

In this sub-section we will estimate equations (2.12) and (2.13) above using Sudanese annual data from 1970 to 1989. As mentioned above, the justification for the interpretation of equation (2.11) as describing the evolution of the equilibrium RER for 'sustainable' levels of the fundamentals, and that error-correction is adequate for the data generating process of the RER, require that the individual variables that enter into the equation be cointegrated. The relatively short length of the data precluded formal tests for cointegration. An informal assessment based on k-variance ratio tests, [24] however, is provided in table (3.5) and graph (3.1). As can be seen from the table and the graph the variance ratios for the differenced series are all lower than their level counterparts, and they converge faster to zero as k grows. Also the table and graph show that the residuals of the long run RER equation are clearly stationary.

The estimation of the cointegration model with the capital flows ratio included did not produce meaningful results. I, therefore, decided to consolidate the two components of domestic absorption $(\frac{NKI}{Y}$ *and* $\frac{G_N}{Y})$ and represent them with the stock of aggregate domestic credit to GDP (DC/Y).

Equations (2.12) and (2.13) are then estimated sequentially and the results of the estimation are reported in equations (3.12') and (3.13') below.

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[24]This measure is proposed by Cochrane (1988). The intuition behind this measure comes from the fact that the ratio (1/k) var $(X_t-X_t-k)$ / Var $(X_t-X_{t-1})$ will be equal to one if Xt has a random walk process, while it converges to zero (as $k \rightarrow \infty$) if $X_t$ follows an AR (1) process for example (see also Kaminsky (1990)).

$$(3.12') \quad \log e_t = \underset{(5.94)}{7.37} - \underset{(-3.21)}{0.30} \log Px_t^* - \underset{(-3.58)}{0.52} \log Pm_t^*$$

$$- \underset{(-1.44)}{0.64} \log (1-t_x)_t - \underset{(-1.90)}{0.62} Log\ (1+t_m)_t$$

$$- \underset{(-2.99)}{0.57} Log\ (\frac{DC}{Y})_t$$

$R^2 = 0.96$, $R^{-2} = 0.94$, DW = 1.39

$$(3.13') \quad \Delta Loge_{t+1} = \underset{(1.88)}{0.75} (\hat{\delta}' F_t - \log e_t) - \underset{(-1.79)}{0.18} \Delta Log\ Px_{t+1}^*$$

$$- \underset{(-3.23)}{0.53} \Delta Log\ Pm_{t+1}^* - \underset{(-1.31)}{0.66} \Delta \log (1-t_x)_{t+1}$$

$$- \underset{(-2.91)}{0.70} \Delta Log\ (1+t_m)_{t+1} - \underset{(-1.30)}{0.26} \Delta \log (\frac{DC}{Y})_{t+1}$$

$$+ \underset{(0.95)}{0.16} \Delta Loge_t - \underset{(-0.44)}{0.04} \Delta LogEo_{t+1}$$

t = 1970 - 87 + 2 Forecasts (1988-89), $R^{-2} = 0.83$, DW = 1.76, Chow (2,8) = 0.48,

Forecast $X^2$ (2)/2 = 1.68

t-statistics are in parentheses. Both equations have high degree of explanation and the error correction equation appears to be adequate for the data generating process with the DW equal to 1.8. The specification is also shown to be stable according to the stability tests as indicated by the

Chow and the large sample statistics, which are both insignificant at conventional significance levels (also see figure (3.2).

Now turning to the interpretation of the results, I consider first the long run equation in (3.12'), the results provide strong support to the prediction of the cointegration model. Foreign prices are shown to have substantial influences on the equilibrium level of RER. The elasticities are -.30 and -.52 for the effects due to the foreign prices of exports and imports, respectively, and the corresponding marginal significant levels are .004 and .002. The implications of this result accommodate the possibility of an asymmetric effect on ERER of a TOT worsening, depending on whether the source of the worsening TOT is brought about by a decline in exports price or an increase in the price of imports. In the first case an equilibrium depreciation is predicted while in the later the ERER is expected to appreciate. This result supports the view that the source of the TOT deterioration matters, and that there exist asymmetries in terms of the interaction between the income and substitution effects, depending on the source of the TOT shock.

The long run effect of domestic absorption (proxied by the log of total domestic credit) is also quite substantial as well, with an elasticity of -.57 and a marginal significant level of .005. The long run elasticity due to export taxes, log $(1-t_x)$ is given by -0.64, while that due to tariffs and other implicit import taxes, $\log(1+t_m)$ is given by -0.62. Even though the effects due to commercial policy are not as significant as the others, we can nonetheless reject the null hypothesis of zero elasticities with 9% and 4% levels, respectively. The above findings have very important implications for the potential impacts of the policy oriented fundamentals on the ERER. A high though sustainable total domestic absorption or a well maintained but restrictive foreign trade regime run the risk of trapping an economy into a lower level of competitiveness.

Second, I consider the error-correction equation which gives the short run dynamic aspects of the RER determination. As in the cointegration case the results strongly support the error

correction model, with the error-correction term estimated at 0.75 (positive and less than one) and significant at 6% significance level. This coefficient reflect the dynamic automatic self correcting mechanism of the error-correction model. If the fundamentals in the previous period call for a higher RER than the observed i.e. $F_t'\delta - \log e_t > 0$ ; then since the coefficient is positive, the level of the RER in the following period will increase. This estimate of automatic adjustment for the Sudan is much larger than the estimate of 0.19 obtained by Edwards(1989) for a group of developing countries using a partial adjustment model. Even though Edwards(1989) method is different from ours, the comparisons suggests that automatic adjustment in the Sudan is more effective than in other developing countries. The coefficients due to $\Delta F_{t+1}$ reflect the short run impacts of transitory changes in the fundamentals. In the short run the effects due to foreign prices have the same signs as in the long run and both are statistically significant; the transitory influence of the foreign price of imports however, is much stronger than the one due to the foreign price of exports. Commercial policy is also shown to have negative and large transitory effects on RER, the effect due to export taxes however, is only marginally significant. Though only slightly significant as well, the short run effect of a temporary rise in domestic absorption is predicted, as expected, to lead to RER appreciation. Finally, the effect of the rate of devaluation of the official exchange rate is both, unexpectedly, negative and highly insignificant. This result which suggest that starting from a position of overvaluation, nominal devaluation in Sudan has not been effective in accelerating the process of real depreciation; does not bode well with the evidence obtained for other developing countries (for example Edwards op.cit.). The full effect of the devaluation, however, may be embedded in the effect due to the term $\Delta\log(\frac{DC}{Y})_{t+1}$, since we could write $\Delta\log(\frac{DC}{Y})_{t+1} = \Delta\log(\frac{DC}{y})_{t+1} - \Delta\log E_{0_{t+1}}$ where

the first term of the right hand side reflects excess aggregate demand as measured by the excess of the rate of growth of domestic credit over that of real output. In this interpretation of the short run effect of domestic absorption a 100% devaluation will lead to a 26% real depreciation in the short-run.

Table (3.1)
Key Indicators of the Agricultural Sector
Role in the Sudan Economy

| INDICATOR | YEAR | (%) |
|---|---|---|
| Share of agriculture in GDP | 1988/89 | 36 |
| Contribution to foreign exchange earnings | 1986/87 | 93 |
| Share to GDP of Govt. investment in agriculture | 1984/85 | 8 |
| Share of total invesment in GDP | 1984/85 | 17 |
| Share of total employment | 1982/83 | 44 |

Source: An updated version of Table 1, Elbadawi (1988)

Table (3.2)
Sectoral Distribution of GDP, Exports and Labor in the Sudan

| Indicator | Year | Agriculture | Manufacturing | Services |
|---|---|---|---|---|
| Percent share in GDP | 1970 | 43 | 15 | 42 |
| | 1980 | 34 | 14 | 52 |
| | 1988 | 36 | 15 | 49 |
| Contribution to value of export (%) | 1970/71 | 89 | 11 | .. |
| | 1977/78 | 95 | 53 | .. |
| | 1982/83 | 90 | 10 | .. |
| Distribution of labor force (%) | 1970/71 | 70 | 3 | 27 |
| | 1977/78 | 69 | 4 | 27 |
| | 1982/83 | 70 | 5 | 31 |

Source: An updated version of Table 3, Elbadawi (1988)

Table (3.3)
Sudan's Real Exchange and its Determinants

| | RER 1/ | TOT | tx | tm | DC/GDP | H/GDP | (M-X)/GDP |
|---|---|---|---|---|---|---|---|
| 1970 | 100.00 | 100.00 | 0.08 | 0.52 | 0.29 | 0.12 | -0.02 |
| 1971 | 94.43 | 100.06 | 0.09 | 0.52 | 0.31 | 0.11 | 0.02 |
| 1972 | 89.36 | 100.59 | 0.08 | 0.49 | 0.34 | 0.12 | 0.02 |
| 1973 | 80.21 | 100.53 | 0.07 | 0.39 | 0.35 | 0.14 | -0.00 |
| 1974 | 64.62 | 103.18 | 0.08 | 0.42 | 0.32 | 0.13 | 0.04 |
| 1975 | 55.46 | 98.69 | 0.08 | 0.30 | 0.42 | 0.12 | 0.13 |
| 1976 | 53.62 | 99.31 | 0.09 | 0.38 | 0.45 | 0.12 | 0.11 |
| 1977 | 40.83 | 101.82 | 0.16 | 0.68 | 0.46 | 0.15 | 0.07 |
| 1978 | 43.00 | 102.87 | 0.12 | 0.51 | 0.46 | 0.18 | 0.09 |
| 1979 | 39.89 | 97.83 | 0.13 | 0.46 | 0.50 | 0.21 | 0.07 |
| 1980 | 40.14 | 90.42 | 0.09 | 0.38 | 0.49 | 0.19 | 0.13 |
| 1981 | 46.30 | 82.46 | 0.16 | 0.41 | 0.53 | 0.23 | 0.15 |
| 1982 | 52.17 | 79.54 | 0.17 | 0.22 | 0.42 | 0.19 | 0.16 |
| 1983 | 44.04 | 90.70 | 0.02 | 0.22 | 0.40 | 0.21 | 0.16 |
| 1984 | 40.79 | 99.30 | 0.05 | 0.48 | 0.39 | 0.20 | 0.08 |
| 1985 | 40.79 | 93.12 | 0.03 | 0.54 | 0.41 | 1.53 | 0.09 |
| 1986 | 41.45 | 95.74 | 0.05 | 0.37 | 0.37 | 0.25 | 0.08 |
| 1987 | 38.57 | 90.57 | 0.05 | 0.36 | 0.39 | 0.24 | 0.03 |
| 1988 | 28.48 | 85.38 | 0.04 | 0.36 | 0.39 | 0.23 | 0.09 |

Notes: 1/ RER=exchange rate for exports/price of nontradables.
(decrease indicates a real appreciation)

Source: Elbadawi (1988)

Table (3.4)
Rates of change in some of Sudan's key macroeconomic indicators
(percent)

| | Money Supply (M1) | Official Reserve | Domestic Credit | Inflation %/\CPI | Real GDP | Official Deval. | Depr. in B.M. rate | RER 1/ |
|---|---|---|---|---|---|---|---|---|
| 1971 | 7.09 | 4.08 | 16.83 | 2.85 | 6.94 | 0.00 | 0.00 | -5.57 |
| 1972 | 16.64 | 109.80 | 19.81 | 6.32 | -2.14 | 0.00 | 2.86 | -5.36 |
| 1973 | 21.61 | 72.90 | 11.76 | 9.67 | -8.07 | 0.00 | 2.78 | -10.24 |
| 1974 | 35.08 | 32.43 | 29.87 | 12.20 | 10.09 | 0.00 | 0.00 | -19.44 |
| 1975 | 18.59 | 40.41 | 58.52 | 6.65 | 12.67 | 0.00 | 0.00 | -14.17 |
| 1976 | 24.49 | 28.49 | 28.15 | 1.42 | 18.41 | 11.90 | 2.70 | -3.33 |
| 1977 | 41.92 | 161.31 | 31.66 | 1.12 | 15.19 | 36.17 | -2.63 | -23.84 |
| 1978 | 27.46 | 52.12 | 24.02 | 12.15 | -1.56 | 32.81 | 8.11 | 5.30 |
| 1979 | 32.04 | 36.60 | 22.71 | 10.84 | -10.37 | 15.29 | 25.00 | -7.22 |
| 1980 | 31.19 | -18.21 | 21.63 | 26.00 | 0.95 | -11.22 | 26.00 | 0.63 |
| 1981 | 39.50 | 99.34 | 34.40 | 17.99 | 2.09 | 17.24 | 42.86 | 15.34 |
| 1982 | 36.59 | 4.37 | 16.08 | 10.76 | 12.68 | 69.61 | 44.44 | 12.67 |
| 1983 | 11.72 | 102.30 | 29.47 | 14.04 | 2.06 | 21.39 | 7.69 | -15.58 |
| 1984 | 18.33 | 13.37 | 19.53 | 16.57 | -5.01 | 16.19 | 21.43 | -7.37 |
| 1985 | 49.94 | 114.52 | 36.45 | 1.52 | -6.28 | 164.34 | 47.06 | -0.00 |
| 1986 | 41.12 | 34.10 | 39.14 | 8.00 | 9.73 | -7.75 | 24.00 | 1.61 |
| 1987 | 32.82 | 21.82 | 38.99 | 7.69 | 1.13 | 12.77 | 19.35 | -6.94 |
| 1988 | 44.41 | -2.43 | 33.26 | 14.02 | -1.90 | 50.82 | 21.62 | -26.16 |

Notes: 1/ RER = exchange rate for exports/price of nontradables
(decrease indicates a real appreciation)

Sources IMF International Financial Statistics, Picks World Currency Yearbook, Elbadawi (1988)

Table (3.5)
VARIANCE-RATIO STATISTICS OF k-DIFFERENCES FOR RER AND ITS FUNDAMENTALS (Equation 3.12')

| | RER | | PX | | PM | | TX | | TM | | DCY | | RESIDUAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| k | statistic | std error | statistic | std error | statistic | std error | statistic | std error | statistic | std error | statistic | std error | statistic | std error |
| 1 | 1.000 | 0.530 | 1.000 | 0.281 | 1.000 | 0.149 | 1.000 | 0.079 | 1.000 | 0.042 | 1.000 | 0.022 | 1.000 | 0.012 |
| 2 | 1.187 | 1.292 | 1.086 | 0.764 | 1.438 | 0.598 | 0.727 | 0.237 | 0.980 | 0.126 | 1.027 | 0.071 | 0.905 | 0.035 |
| 3 | 1.184 | 1.990 | 0.909 | 1.013 | 1.543 | 0.875 | 0.584 | 0.286 | 0.675 | 0.108 | 0.831 | 0.050 | 0.542 | 0.015 |
| 4 | 1.222 | 2.822 | 0.868 | 1.414 | 1.240 | 1 012 | 0.493 | 0.288 | 0.485 | 0.081 | 0.844 | 0.039 | 0.307 | 0.007 |
| 5 | 1.275 | 3.801 | 0.778 | 1.763 | 0.859 | 0.903 | 0.426 | 0.229 | 0.413 | 0.057 | 0.763 | 0.026 | 0.162 | 0.002 |

| | delta RER | | delta PX | | delta PM | | delta TX | | delta TM | | delta DCY | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| k | statistic | std error | statistic | std error | statistic | std error | statistic | std error | statistic | std error | statistic | std error |
| 1 | 1.000 | 0.530 | 1.000 | 0.281 | 1.000 | 0.149 | 1.000 | 0.079 | 1.000 | 0.042 | 1.000 | 0.022 |
| 2 | 0.538 | 0.586 | 0.728 | 0.232 | 0.904 | 0.114 | 0.538 | 0.033 | 0.728 | 0.013 | 0.904 | 0.007 |
| 3 | 0.370 | 0.622 | 0.361 | 0.126 | 0.781 | 0.055 | 0.370 | 0.011 | 0.361 | 0.002 | 0.781 | 0.001 |
| 4 | 0.288 | 0.665 | 0.294 | 0.113 | 0.456 | 0.030 | 0.288 | 0.005 | 0.294 | 0.001 | 0.456 | 0.000 |
| 5 | 0.257 | 0.766 | 0.226 | 0.103 | 0.316 | 0.019 | 0.257 | 0.003 | 0.226 | 0.000 | 0.316 | 0.000 |

Notes Standard errors are computed according to Bartlett asymptotic procedure.
RER = (Exchange rate/Price of non tradables)
Pm = Foreign price of imports
Px = Foreign price of exports
tx = export tax rate
tm = import tax rate
DCY = Domestic Credit/GDP

# Figure (3.1)

# VARIANCE RATIO STATISTICS OF k-DIFFERENCES OF RER AND ITS FUNDAMENTALS (Equation 3.12')

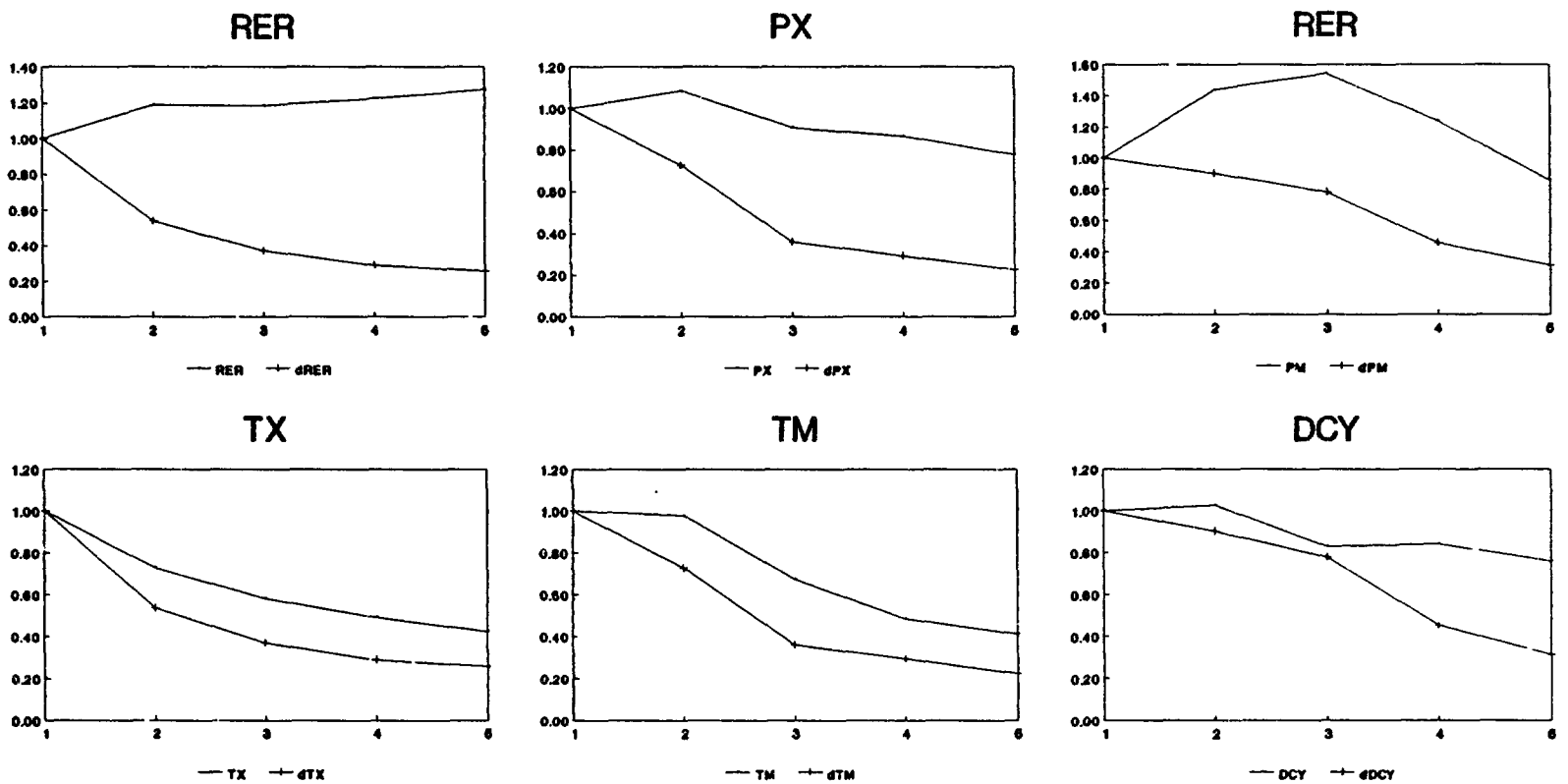
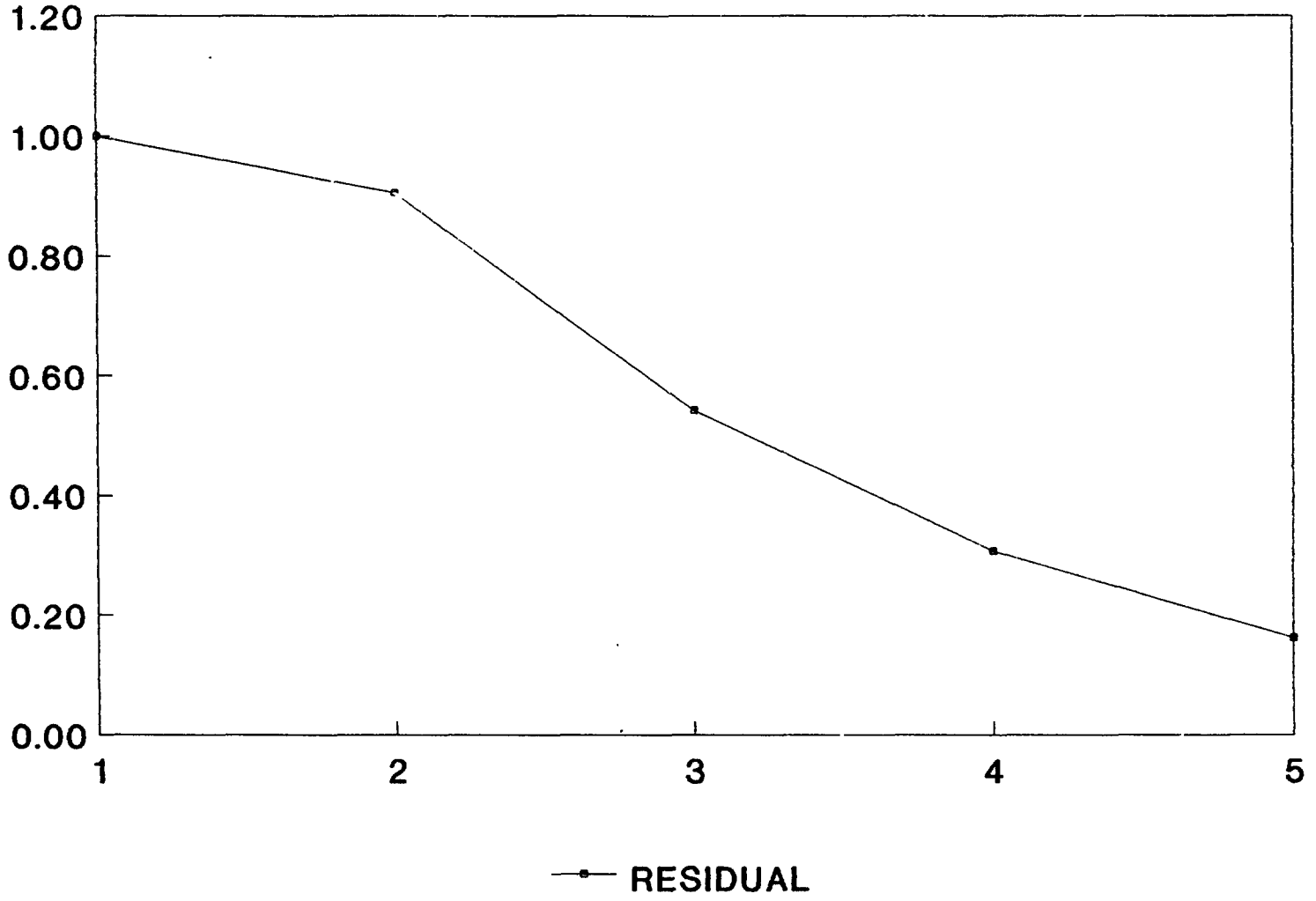


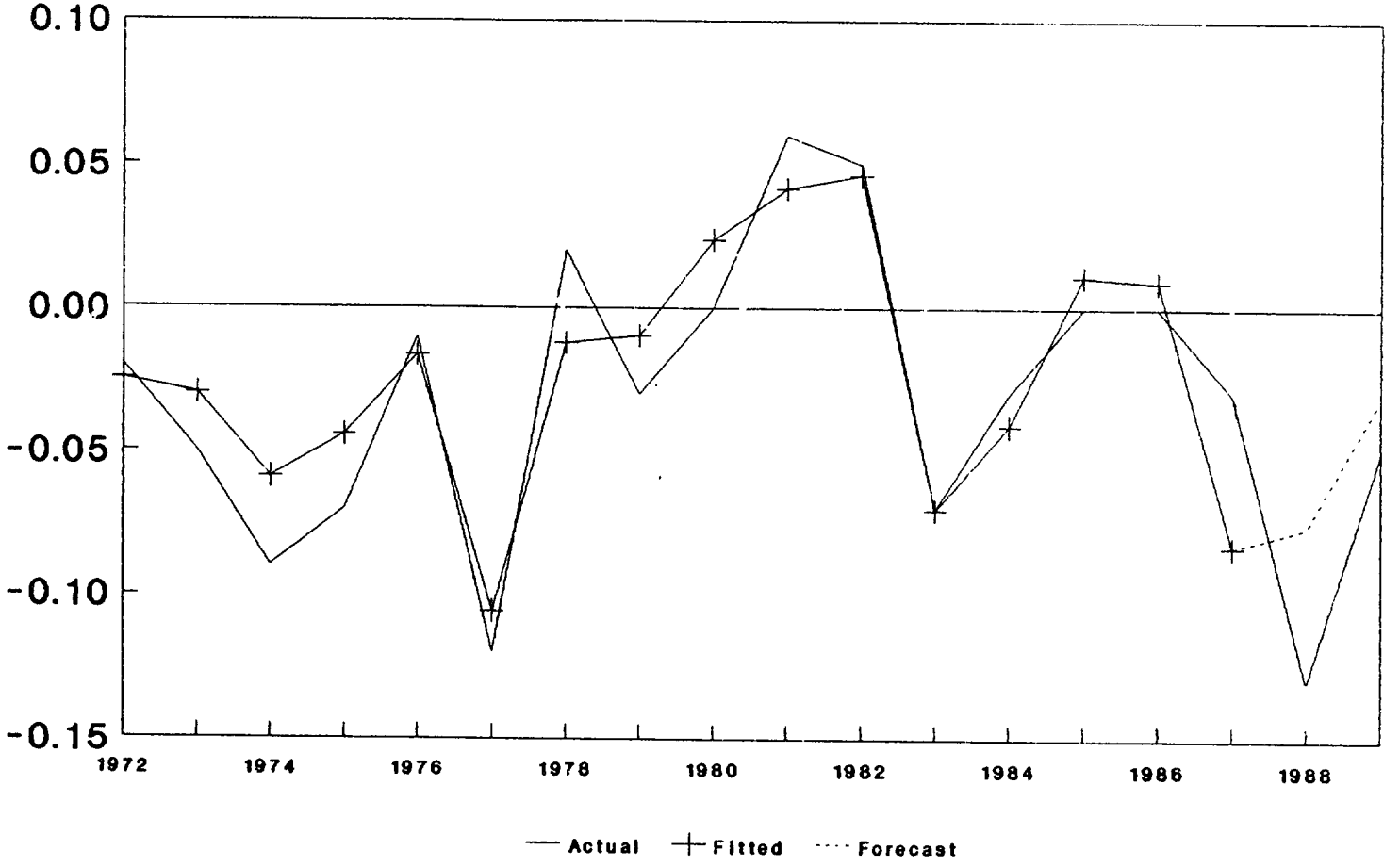
Figure (3.1) contd.

VARIANCE RATIO STATISTICS OF k-DIFFERENCES OF THE RESIDUAL




Based on equation 3.12'

# Figure 3.2
# RATE OF CHANGE OF RER IN SUDAN
## (Actual, Fitted and Forecast)




Note: Based on Eqn.(3.13') in the text.

# 4. REAL OVERVALUATION AND THE TAXATION OF AGRICULTURE IN SUDAN

## 4.1 Equilibrium RER and Overvaluation

Now we can proceed to compute an index for ERER using the estimates of equation (3.8') above for given 'sustainable' or 'permanent' values of the fundamentals. The permanent components of the fundamentals are obtained by using the time series technique introduced by Beveridge and Nelson(1981) and further elaborated upon by Nelson and Plosser (1982), Cuddington and Winters (1987), and Cuddington and Urzua (1989). Beveridge and Nelson (1981) show that any variable $x_t$ with an integrated process (ie. a unit root) can be decomposed into a random walk with drift and stationary component, ie.

$$(4.1) \qquad x_t = x_{t-1} + \mu_t + C(L)\, \epsilon_t$$

This technique is desirable for the problem at hand because unlike the trend stationary model based decomposition it allows the steady state growth path of the time series to shift upwards or downwards over time. Fluctuations around the (shifting) permanent path reflect cyclical effects. The stochastic and growing nature of the permanent fundamentals predicted by this procedure is indeed a minimal identification condition for the derived ERER to be consistent with the concept of RER equilibrium as outlined in section 2 above.

The decomposition procedure is based on the following steps. The first step is to take logarithms of the individual variables and then first difference to obtain stationary series. Second, the Box-Jenkins technique is used to identify and estimate an ARIMA model. The results of the estimated models are shown in the appendix table (A.4.1 ). Third, using the steady state "gain function" approach (Cuddington and Winter (1987)), a first order difference equation in the permanent component of the series can be obtained as a linear function of the corresponding

residuals. Finally, using the computational technique suggested in Beveridge and Nelson, and Cuddington and Winters, the difference equations can be solved for the levels of the permanent components. The transitory component then obtains as the permanent minus the observed series. Figures (A.4.1) - (A.4.6) (of the appendix) show the permanent and transitory components of the variables in question.

The derived ERER series is shown in Figure (4.1) together with the actual RER series, where the two series are set to equal to 100.00 in 1970. This anchoring of the two rates is needed for the estimation of the degree of overvaluation. Despite the arbitrariness in this choice, given the development of the economy, 1970 is an appropriate base period to assume equality for the two rates. An important stylized fact emerges from the above graph. The equilibrium real exchange rate, being a functional of its changing fundamentals, can in fact undergo considerable variability. It follows that at least some portion of observed RER variability may be related to equilibrium behavior, and that analyses of real exchange rate misalignment based on historical comparisons of observed RER levels (i.e., the PPP approach) may lead to erroneous conclusions.

A closer look at the extent of real misalignment is provided by Table (4.1), which gives the average annual percentage excess of the RER over its equilibrium level. The results of the table show steadily increasing real overvaluation over the second half of the 1970's, with overvaluation increasing from 8% in 1974 to 16% in 1979. As described in section (3) above this period was one of expansive macroeconomic policy and exogenous terms of trade shocks triggered by the post 1973 oil price hike. This later exogenous effect is predicted successfully by the model as the index of real overvaluation reached 8% in 1974 which is more than 250% of the level in 1973. Despite the failure of the IMF-assisted reform program of the 1980's, it appears that real depreciation was achieved and consequently real overvaluation declined steadily from 16% in 1979 (when the program started in September) to 11% in the following year. Overvaluation then declined sharply to only 3% in 1981,

and in 1982 there was an undervaluation of more than 5%; at this stage of the program, substantial liberalization of exports has been effected. The following two years witnessed a rise in overvaluation to 5% and 7% in 1983 and 1984, respectively, as economic reforms slowed or temporarily stalled. Overvaluation once again came down in 1985-86, where it declined to 3% and 5% respectively. This is made possible basically by the adoption of a more depreciated nominal exchange rates for exports, even though no integrated macroeconomic reform was in effect. During the last three years 1987-89, overvaluation increased steadily from 7% in 1987 to 17% in 1988, to reach 19% in 1989. 1988 marked the beginnings of a move away from reforms which developed into a major policy reversals since the second half of 1989.

4.2 Direct and Indirect Taxation of Agriculture

As explained by Krueger, Schiff, and Valdés (1988), Hereafter (KSV), there are four well-known stylized facts about the agricultural policies of developing countries. First most countries have attempted to promote industrial development through trade protectionism, second the exchange rate has been kept overvalued as a result of restrictive trade and payment regimes. Third, agricultural prices are generally suppressed through marketing boards, forced procurement, export taxation, etc. Fourth, some governments, have attempted to affect or partly neutralize the effects on agriculture of the above interventions by investing in agricultural supply such as irrigation, research and extension; by subsidizing input prices or extending cheap credit to farmers. Also as noted by (KSV); the consequence of and interactions among, these interventions have not been fully appreciated.

We focus here on assessing the extent of the impact on Sudanese agriculture due to direct interventions (the last two set of policies) and its indirect counterpart provided by the first two types of interventions. The methodology used to derive these indices is given in (KSV). A slightly adopted version of (KSV) formula is given below :

We start by introducing some definitions. Let $P_t$ be the domestic producer price of the aggregate tradeable agricultural product (and adjusted for transports, storage, and other marketing costs). Let $P_B = P_B^*.E_{AT}$ be the border price $P_B^*$ evaluated at the official nominal exchange rate applied for agriculture tradables. Let $P_{NA} = \alpha P_{NAT} + (1-\alpha) P_{NAH}$ be the nonagricultural sector price index which is a weighted average of the nonagricultural tradable price index $P_{NAT}$ and the nonagricultural home good price index $P_{NAH}$. Let $P_B^e = P_B^*.E^e$ be the border price evaluated at the equilibrium nominal exchange rate $E^e$. And let $P_{NA}^e = \alpha P_{NAT}^* E^e + (1-\alpha) P_{NAH}$, where $P_{NAT}^* = P_{NAT}/E_{NAT}(1+t_{NAT})$, $E_{NAT}$ is the nominal exchange rate applicable for NAT, and $t_{NAT}$ is the rate of taxes on nonagricultural tradables. $P_{NA}^e$ therefore is the nonagricultural price index where the price index of the tradeable part is evaluated at the equilibrium nominal exchange rate, $E^e$, and in the absence of trade policy affecting nonagricultural tradables.

Then the direct nominal protection rate, which measures the difference between the relative domestic price and the relative border prices as a ratio to the relative price at equilibrium, is

$$(4.2) \qquad NPR_D = \frac{(P_t/P_{NA} - P_B/P_{NA})}{(P_B^e/P_{NA}^e)}$$

This index measures the effect of price controls, export taxes or quotas and the other policies directly affecting $P_t$. The indirect nominal protection rate which measures the effect of the disparities between the official $E_{AT}$ from its equilibrium, and the inter-tradeable effect of trade policy on $P_{NAT}$, is

$$(4.3) \qquad NPR_I = \frac{P_B / P_{NA}}{P_B^e / P_{NA}^e} - 1$$

Note that the total nominal protection rate is given as:

$$(4.4) \qquad NPR_T = NPR_D + NPR_I = (P_f / P_{NA}) / (P_B^e / P_{NA}^e) - 1.$$

In our case we use an equilibrium real exchange rate, $\tilde{e} = (E/P_{NAH})^e$ , instead of the nominal equilibrium rate $E^e$. This requires adjusting the formula for $P_B^e / P_{NA}^e$ in equations (4.2) and (4.3) as below:

$$(4.5) \qquad P_B^e / P_{NA}^e = \frac{P_B^* . \tilde{e}}{\alpha P_{NAT}^* \tilde{e} + (1-\alpha)},$$

where $\tilde{e}$ is the equilibrium RER.

Using annual Sudanese data (see appendix table (A.4.2) and our ERER and overvaluation derived estimates in equations (4.2) - (4.5) above, I calculated the direct, indirect, and total indexes of taxation imposed on Sudanese agriculture.

The results are shown in table (4.2) below. The numbers on direct intervention provide estimates of the percentage by which domestic producers' prices diverge from those that would have prevailed in an environment with no taxes on agricultural tradables (given the actual exchange rate and the degree of industrial protection). This measure is equivalent to the rate of nominal protection, KSV (1988). The results reveal that direct interventions have been rather substantial over the first half of 1970s with an annual average in excess of 20%. For the following period however, direct taxation of agriculture declined considerably to average less than 10% per year and in 1987 and 1988 it even dropped to less than 4%. This evidence is partially explained by the fact that the

Sudanese government is apparently pursuing a policy of self-sufficiency in food grains based on extending sector specific price protection.

The table also contains the estimates of indirect interventions; which includes both the effects of trade and macroeconomic policies on the real exchange rates, and the extent of protection afforded to nonagricultural commodities. As the numbers show, the most devastating impact on agriculture is provided by this economy wide interventions. Since 1975, the cost of indirect intervention to the Sudanese agriculture have accounted for about five times that of direct taxation. The extent of indirect taxation increased steadily from an annual average of less than 20% for 1970 - 1973, to 40% for 1974 - 76, before jumping to an annual average of 55% during 1977-80. The cost of indirect intervention only partially declined to an average of 42% per annual for the two years 1981-82, before rising to an annual average of more than 55% for the following years. This brief decline in $NPR_t$ could not match the reductions in RER overvaluation over the first half of the 1980s. Actually as can be seen from Figure (4.2), real overvaluation is transmitted into agriculture with a magnification effect. Among other determinants, we will study in the next section the extent to which such severe taxation (especially the indirect) has impacted the growth of agriculture in Sudan.

Table (4.1)
Equilibrium Real Exchange Rate and Overvaluation in Sudan

| | Real Exchange Rate (Eat/Pn) | Equilibrium Exchange Rate | Overvaluation |
|---|---|---|---|
| 1971 | 100.00 | 100.00 | 0.00 |
| 1972 | 98.99 | 99.27 | 0.28 |
| 1973 | 97.01 | 99.77 | 2.85 |
| 1974 | 93.05 | 100.46 | 7.96 |
| 1975 | 90.26 | 98.12 | 8.71 |
| 1976 | 89.63 | 97.01 | 8.22 |
| 1977 | 84.65 | 98.82 | 16.75 |
| 1978 | 85.59 | 98.41 | 14.97 |
| 1979 | 84.22 | 98.02 | 16.38 |
| 1980 | 84.33 | 93.54 | 10.91 |
| 1981 | 86.95 | 89.53 | 2.97 |
| 1982 | 89.13 | 84.28 | -5.44 |
| 1983 | 86.03 | 90.03 | 4.65 |
| 1984 | 84.63 | 90.40 | 6.82 |
| 1985 | 84.63 | 86.94 | 2.73 |
| 1986 | 84.92 | 89.06 | 4.87 |
| 1987 | 83.60 | 89.48 | 7.02 |
| 1988 | 78.05 | 90.95 | 16.52 |
| 1989 | 75.89 | 90.55 | 19.31 |

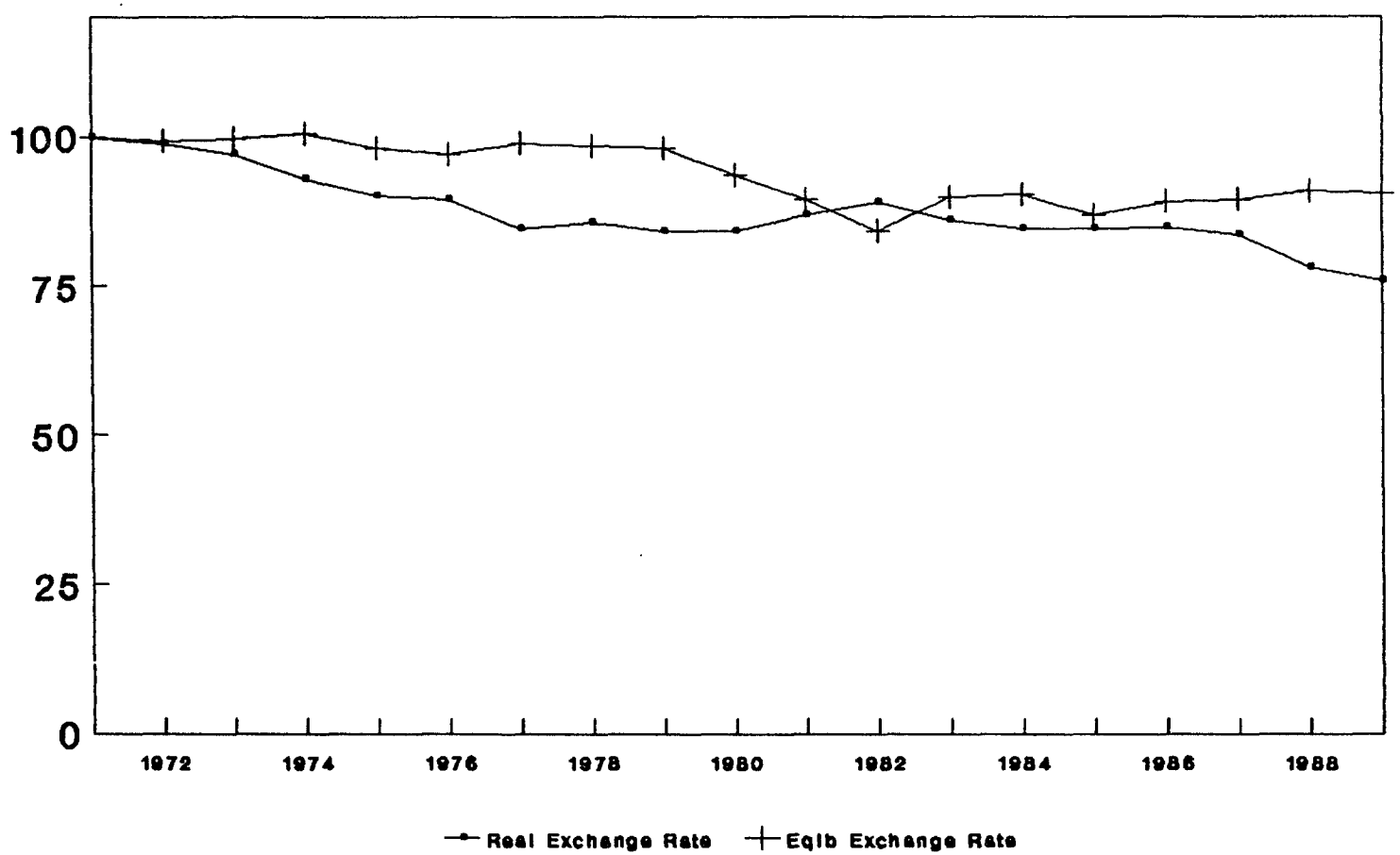
Eat/Pn = (Exchange rate for agricultural tradables/Price of non-tradables)

Table (4.2)
Taxation of Sudanese Agriculture
(Percent)

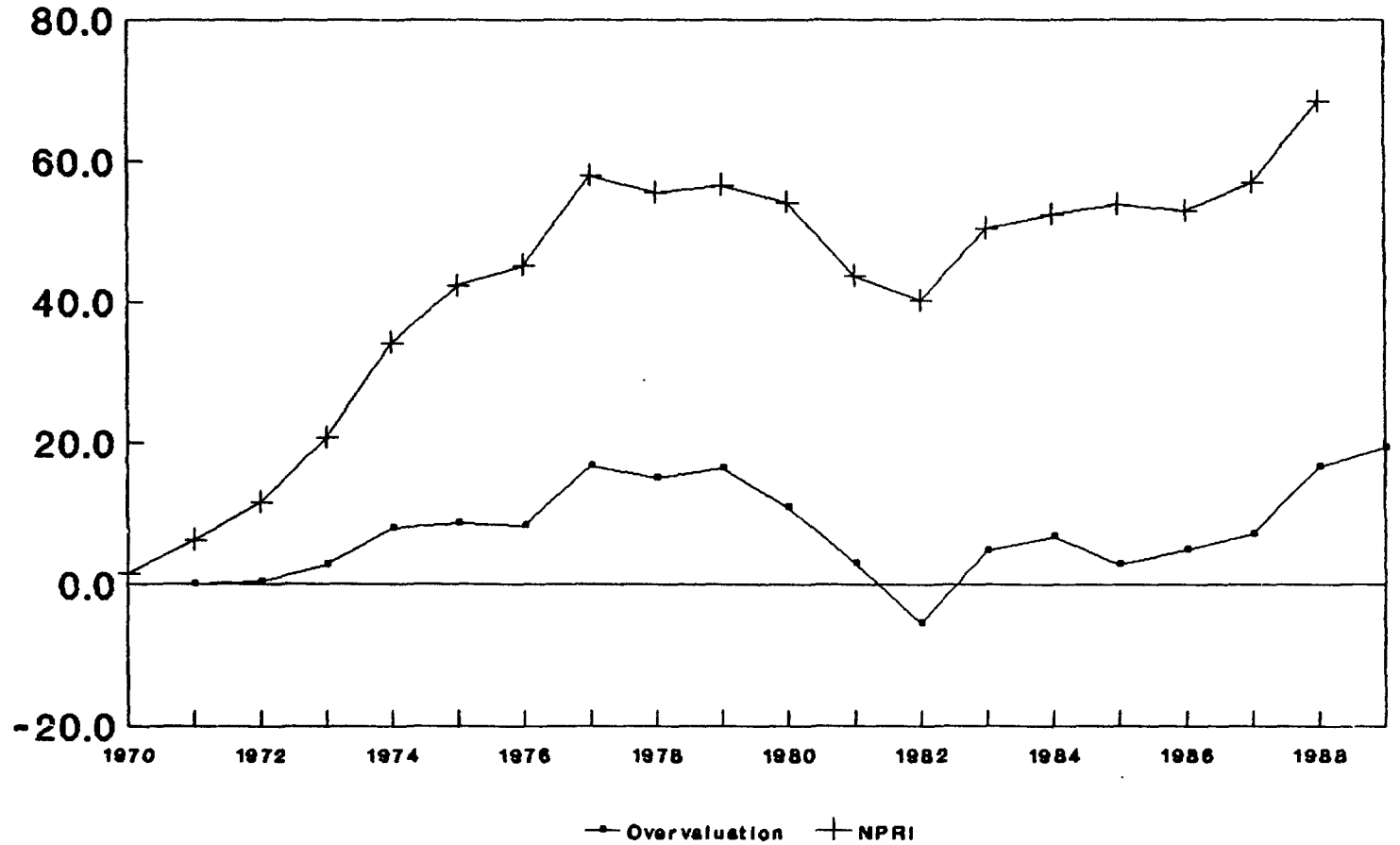
| | NPRI | NPRD | NPRT |
|---|---|---|---|
| 1970 | 1.54 | 20.94 | 22.48 |
| 1971 | 6.15 | 21.03 | 27.18 |
| 1972 | 11.53 | 18.40 | 29.92 |
| 1973 | 20.72 | 16.95 | 37.67 |
| 1974 | 34.17 | 15.85 | 50.02 |
| 1975 | 42.24 | 13.14 | 55.39 |
| 1976 | 45.17 | 11.32 | 56.49 |
| 1977 | 57.91 | 8.99 | 66.90 |
| 1978 | 55.49 | 8.95 | 64.43 |
| 1979 | 56.51 | 8.58 | 65.09 |
| 1980 | 54.17 | 10.08 | 64.25 |
| 1981 | 43.55 | 11.92 | 55.47 |
| 1982 | 40.22 | 12.07 | 52.29 |
| 1983 | 50.37 | 9.22 | 59.59 |
| 1984 | 52.51 | 9.67 | 62.18 |
| 1985 | 53.83 | 8.68 | 62.51 |
| 1986 | 52.87 | 5.51 | 58.38 |
| 1987 | 56.86 | 3.37 | 60.23 |
| 1988 | 68.37 | 3.76 | 72.12 |

Notes:
NPRI = index of indirect rate of taxation on agriculture
NPRD = index of direct rate of taxation on agriculture
NPRT = NPRI + NPRD

## Figure (4.1)
# Equilibrium Real Exchange Rate and Overvaluation in Sudan



# Figure (4.2)
# Real Overvaluation and Indirect Taxation of Agriculture in Sudan



## 5. AN EMPIRICAL MODEL OF ENDOGENOUS AGRICULTURAL GROWTH IN SUDAN

Using the derived indexes of direct and indirect taxation on agriculture obtained in the previous section, I now test the implications of the endogenous growth model ala Easterly (1990) on Sudanese agriculture. The endogenous growth model allows for economic distortions to influence economic growth along with other traditional determinants such as the stock of physical and human capital, and the model predicts this distortion induced effect to lead to deceleration in real output.

I estimated the model for two measures of agricultural growth: the rate of growth in real agricultural output (GDP), and the share of agriculture in real aggregate GDP.[25] In addition to the two measures of distortions ($NPR_D$ and $NPR_I$), the specification includes the rate of population growth (age 15-64) as proxy for labor force, and the investment rate ($I/GDP_{-1}$)[26]; the last two factors being representative of the more conventional sources of growth.

Two further factors are included in the estimation as well, in order to reflect stylized facts of the growth process in SSA. In the light of the observation made by Ndulu (1990) - and referred to in section (1) above - regarding the role of intermediate goods imports in capacity utilization and the evidence that the deceleration of growth in SSA over the last decade may at least partially be explained by the decline in capacity utilization and compression of imports; I included the rate of growth of real intermediate imports for agriculture as a potential determinant. The second factor included is the growth rate in the permanent level of TOT. This factor provides an opportunity for testing the hypothesis of the exogeniety of growth in SSA. According to this hypothesis, permanent

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[25]Strictly speaking, this is not a direct, measure of growth but since agriculture is the most dominant sector of the economy in most of SSA, a decline in its share of the economy is likely to be associated by a slower or 'distorted' aggregate growth.

[26]Perhaps a better measure in this case would be the share of agriculture in aggregate investment. Data limitations however precluded this option.

shocks in TOT still affect growth even when it was accommodated through real depreciation (as represented by $NPR_I$).

The two equations were estimated using Sudanese annual data from 1971-1988. The results are reported in equations (5.1) and (5.2) below.

$$(5.1)\quad \left(\frac{\Delta GDPag}{GDPag}\right)_t = \underset{(2.35)}{1.79} \underset{(-2.63)}{-9.24}\, NPR_{D_t} \underset{(-2.19)}{-2.12}\, NPR_{I_t} + \underset{(2.95)}{2.12}\left(\frac{I}{GDP_{-1}}\right)_t + \underset{(0.03)}{0.05}\left(\frac{\Delta \overline{TOT}}{\overline{TOT}}\right)_t - \underset{(-0.36)}{0.01}\left(\frac{\Delta IMP}{IMP}\right)_t - \underset{(-1.50)}{0.40}\left(\frac{\Delta GDPag}{GDPag} - Average\frac{\Delta GDPag}{GDPag}\right)_{t-1}$$

$R^2 = 0.56$, $R^{-2} = 0.29$, DW = 2.02

$$(5.2)\quad \left(\frac{GDPag}{GDP}\right)_t = \underset{(14.91)}{0.44} \underset{(-3.98)}{-0.22}\, NPR_{I_t} \underset{(2.03)}{0.22}\left(\frac{I}{GDP_{-1}}\right)_t + \underset{(1.87)}{0.57}\left(\frac{\Delta \overline{TOT}}{\overline{TOT}}\right)_t \underset{(-1.19)}{-0.05}\left(\frac{\Delta G.CON.}{G.CON.}\right)_t - \underset{(-1.02)}{0.004}\left(\frac{\Delta IMP}{IMP}\right)_t$$

$R^2 = 0.73$, $R^{-2} = 0.62$, D.W. = 1.74

t- statistics are in parenthesis.

The results show both measures of distortions to have - as expected - negative influences on the growth of real agricultural output (equation (5.1)); the influence of direct taxation is much stronger in terms of magnitude, however. Only indirect taxation affects the share of agriculture in

aggregate output, however (equation (5.2)). Direct taxation was not found to be significant and therefore subsequently dropped from equation (5.2). In any case the strong results obtained for the influence of aggregate economic distortions on agricultural growth as well as its share in the economy, in addition to the fact that the distortions have increased quite substantially from intermediate levels, corroborate the predictions of the Easterly (1990) model which shows that the impact on growth is likely to be larger, the larger the increase in distortions starting from intermediate initial levels.

For both measures of agricultural growth, investment has appreciable and statistically significant effect. The factor reflecting the role of labor was not found to be significant in each of the two specification and was therefore dropped from both equations. The factor representing the effect of capacity utilization as reflected by the rate of growth of intermediate goods' imports, has a perverse but insignificant effect in each of the two specifications. On the other hand, there is some weak evidence that permanent deterioration in the TOT tend to reduce the share of agriculture in aggregate output. Real growth rate in agriculture, however, does not seem to be influenced by the exogenous factor (TOT shock) beyond its effect through overvaluation. The evidence - at least for the share of agriculture in the economy - supports the widely held view regarding the exogeniety of growth in SSA (e.g. Ndulu (1990)).[27] This also shows the vulnerability of agriculture in Sudan (and SSA) to permanent worsening of TOT even when domestic corrective measures were taken to accommodate the TOT shock. The evidence on the non-relevance of the effect due to import compression - induced decline in capacity utilization noted for SSA (e.g. Ndulu (1990)), is contrary

[27]In fact permanent TOT deterioration would lower equilibrium share of agriculture in the economy. This does not say that growth is determined by external TOT. But here I am implicitly assuming that at this early stage of the development of SSA; the global growth of its economy requires a rising share for agriculture-especially export-oriented agriculture, so that the process of structural transformation towards a more diversified and fast growing economy can be achieved.

to the widely held view regarding the importance of this effect in SSA.[28] Finally the negative sign of the coefficient of the deviation term in equation (5.1) shows that growth in agriculture tend to revert to the average where previous period higher than average growth rates get corrected for in the following period.

[28]Given the very few observations available for the estimation of this effect and others, further and more robust application of the model is needed, perhaps in the context of a broadly based panel data from SSA.

## 6. CONCLUSIONS

Starting from the premise that agriculture should play a pivotal role in the process of structural transformation and economic development in Sub-Saharan Africa, this paper addressed two inter-related issues in this regard. The first issue is the extent to which policy induced distortions tax agriculture by causing the structure of incentives to be biased against the sector in Sub-Saharan Africa. Here the paper distinguished between two types of policy induced distortions: the direct one which is induced by micro and sectoral policies directly deployed on agriculture, and the implicit or indirect set of distortions caused by policies directed at the macroeconomic management of the economy. The second issue considered in the paper is the consequence for the growth of agriculture of these distortions given other relevant growth fundamentals. The potential deleterious effects on economic growth of such distortions have been the subject of study in the recent endogenous growth literature (e.g. Easterly (1990) and Easterly and Wetzel (1989).

In the introduction section of this paper, preliminary evidence on the extent of economic distortions in Sub-Saharan Africa is reviewed. The evidence on agricultural prices in six major Sub-Saharan African countries show that despite variations across countries, farm gate prices remain generally lower compared to their equivalent border prices. Furthermore, worsening macroeconomic conditions in Sub-Saharan Africa, such as high and unsustainable fiscal deficits, worsening terms of trade, and dwindling foreign aid, have meant that the ability of Sub-Saharan African countries to invest in agricultural supply and therefore partially mitigate the potential negative consequence of such distortions on agriculture, is substantially reduced. With regard to indirect taxation of agriculture, the analysis of Sub-Saharan Africa wide real exchange rate and its fundamentals shows sustained real appreciation over most of the 1970's and the first half of the 1980's while major fundamentals such as the terms of trade and capital flows call for equilibrium real depreciation. It is likely, therefore, that real exchange rates in SSA have been overvalued over the period. This

evidence on the direct and indirect distortions is consistent with the declining shares of agriculture and the general worsening positions of the economies of SSA over the period.

The second section of the paper developed a forward-looking real exchange rate model which allows the derivation of an equilibrium real exchange rate that is consistent with both home goods and current account equilibriums. In sections 3 and using data from the Sudan - an African country with sizable agriculture - this model is estimated and used to generate an index for the equilibrium rate for sustainable levels of the fundamentals, where sustainability is given by the permanent components of the data on fundamentals as obtained by time series decomposition. In section 4, the derived equilibrium real exchange rate index is used to derive indexes of direct and indirect taxation of agriculture in the Sudan following the procedure outlined in KSV (1988). The results corroborate evidence obtained from other studies (e.g KSV) in that direct taxation of agriculture tend to decline over the years perhaps as a partial requirement to enhance self-sufficiency in foodgrains for example. Direct taxation, however, has generally been dominated by indirect taxation which remains high and in the case of the Sudan it averaged more than five times the former form of taxation since 1975.

Finally in section 5, the two above indexes along with other growth fundamentals were used to test the implications of the endogenous growth model (ala Easterly (1990)) on sudanese agriculture. The estimation results show strong, negative and statistically significant effects on Sudanese agriculture for distortions as measured by the indexes of direct and indirect taxation. These results coupled with the fact that the distortions have increased quite substantially from relatively low levels, corroborate the predictions of the Easterly (1990) model which shows that the impact on growth is likely to be larger, the larger the increase in distortions and the smaller their initial levels. The results also as expected, provide strong support for the role of investment in the growth of agriculture, we could not, however, obtain significant influence for human capital, the other conventional growth fundamental. Lastly the slightly significant and negative effect due to permanent

change in the terms of trade indicates that agriculture in the Sudan could be vulnerable to permanent worsening of TOT even when domestic policy measures were taken to accommodate the shock.

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# APPPENDIX

Table (A.4.1)

Series Decomposition: ARIMA Estimation

| SERIES | MODEL | $R^2$ | DW |
|---|---|---|---|
| Log (DC/Y) | $(1-0.615L^2)\ \Delta\log(\frac{DC}{Y})_t = 0.854L^2\,\hat{e}_t$ | 0.31 | 1.65 |
| Log $P_x^*$ | $(1-0.480L^2)\ \Delta\log P_{x_t}^* = -0.974L^2\,\hat{e}_t$ | 0.36 | 2.09 |
| Log $P_m^*$ | $(1-0.814L^3)\ \Delta Log P_{m_t}^* = 0.029 + 0.567L^1\hat{e}_t$ | 0.56 | 1.94 |
| Log (1-tx) | $\Delta Log(1-tx)_t = -0.408L^1\hat{e}_t$ | 0.14 | 1.98 |
| Log (1+tm) | $(1+0.507L^1+0.614L^2)\ \Delta Log\ (1+tm)_t = -0.961L^3\ \hat{e}_t$ | 0.62 | 1.68 |
| Log RER | $(1-0.699L^2)\ \Delta RER_t = -0.862L^2\ \hat{e}_t$ | 0.09 | 1.71 |

Table (A.4.2)
Basic Data used in the computation of Taxation of Agriculture in Sudan

| | Pnat | tx | tm | Pat(*) | Pat(f) | Pnat(*) | Eat | Enat |
|---|---|---|---|---|---|---|---|---|
| 1970 | 100.0 | 0.08 | 0.52 | 100.0 | 82.8 | 188.0 | 0.35 | 0.35 |
| 1971 | 102.2 | 0.09 | 0.52 | 102.5 | 79.2 | 192.1 | 0.35 | 0.35 |
| 1972 | 107.5 | 0.08 | 0.49 | 104.1 | 96.6 | 189.9 | 0.36 | 0.38 |
| 1973 | 123.9 | 0.07 | 0.39 | 121.8 | 104.5 | 222.8 | 0.37 | 0.40 |
| 1974 | 150.8 | 0.08 | 0.42 | 166.1 | 114.2 | 265.5 | 0.37 | 0.40 |
| 1975 | 176.3 | 0.08 | 0.30 | 168.7 | 143.1 | 339.0 | 0.37 | 0.40 |
| 1976 | 178.1 | 0.09 | 0.38 | 165.7 | 164.5 | 322.6 | 0.38 | 0.40 |
| 1977 | 252.1 | 0.16 | 0.68 | 219.0 | 187.6 | 375.1 | 0.37 | 0.40 |
| 1978 | 255.5 | 0.12 | 0.51 | 231.5 | 259.3 | 376.0 | 0.40 | 0.45 |
| 1979 | 322.4 | 0.13 | 0.46 | 194.8 | 278.2 | 408.9 | 0.50 | 0.54 |
| 1980 | 387.9 | 0.09 | 0.38 | 141.2 | 256.1 | 432.4 | 0.63 | .0.65 |
| 1981 | 479.5 | 0.16 | 0.41 | 108.9 | 305.3 | 500.1 | 0.90 | 0.68 |
| 1982 | 622.0 | 0.17 | 0.22 | 93.8 | 364.3 | 499.8 | 1.30 | 1.02 |
| 1983 | 813.3 | 0.02 | 0.22 | 154.0 | 616.2 | 414.1 | 1.40 | 1.61 |
| 1984 | 1036.9 | 0.05 | 0.48 | 192.3 | 809.0 | 374.7 | 1.70 | 1.87 |
| 1985 | 1486.8 | 0.03 | 0.54 | 123.5 | 1086.0 | 329.5 | 2.50 | 2.93 |
| 1986 | 1861.7 | 0.05 | 0.37 | 172.2 | 2057.4 | 402.0 | 3.10 | 3.38 |
| 1987 | 2454.4 | 0.05 | 0.36 | 195.4 | 2876.9 | 593.7 | 3.70 | 4.50 |
| 1988 | 3214.9 | 0.04 | 0.36 | 196.5 | 3548.9 | 777.6 | 4.50 | 9.00 |

Notes: Pnat = indexed price of non agricultural tradables
tx = tax on exports
tm = tax on imports
Pat(*) = foreign price of agricultural exports (US$)
Pat(f) = farmgate prices for agricultural tradables (LS/MT)
Pnat(*) = [Pnat/(Enat(1+tm)]
Eat = exchange rate for exports (Ls/US$)
Enat = exchange rate for non agricultural tradables (Ls/US$)

Source Elbadawi 1988

Figure A.1.1

# REAL EXCHANGE RATE

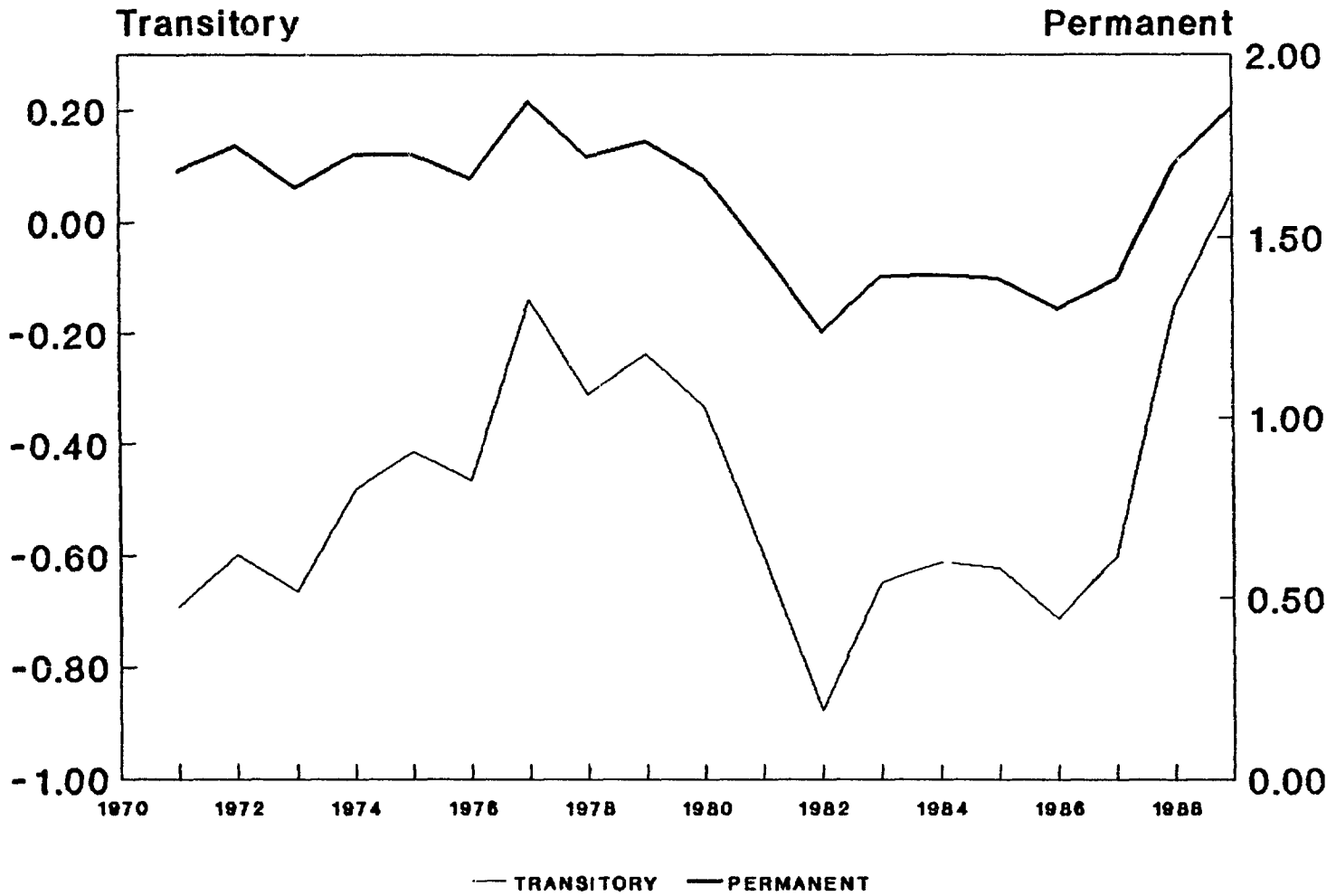


Figure A.1.2

# FOREIGN PRICE OF EXPORTS

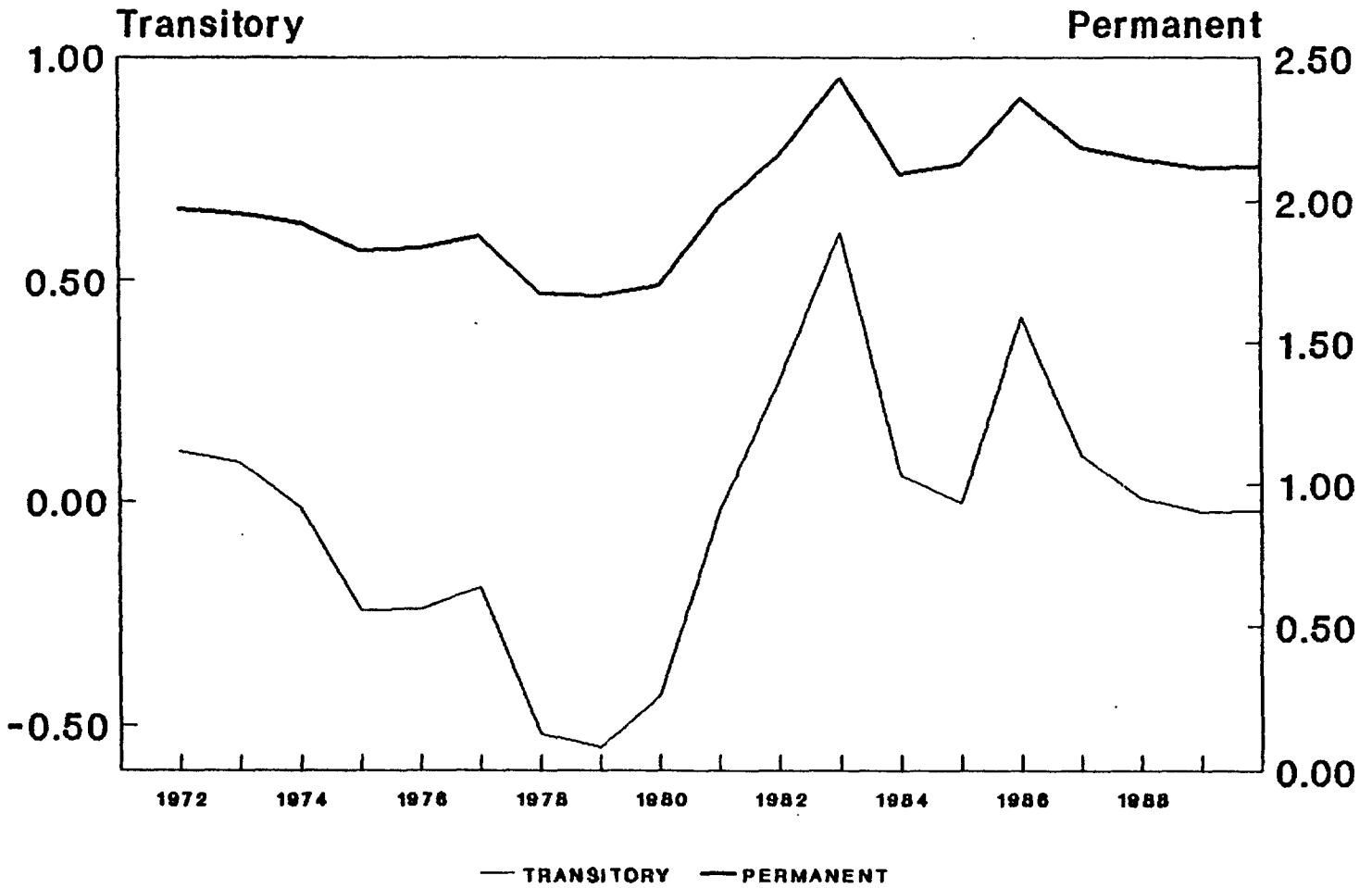


Figure A.1.3

# FOREIGN PRICE OF IMPORTS

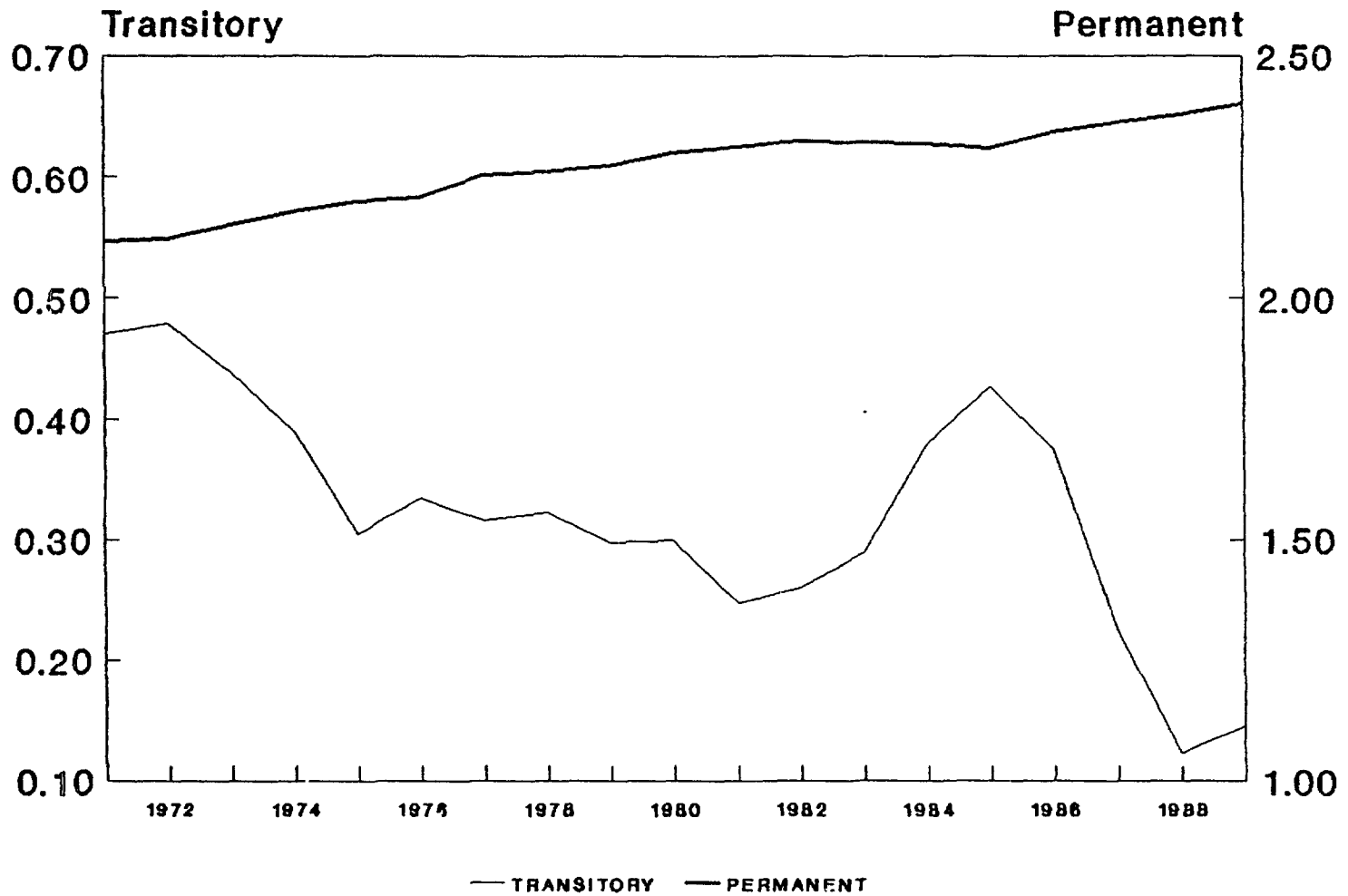


Figure A.1.4

# TAX ON EXPORTS

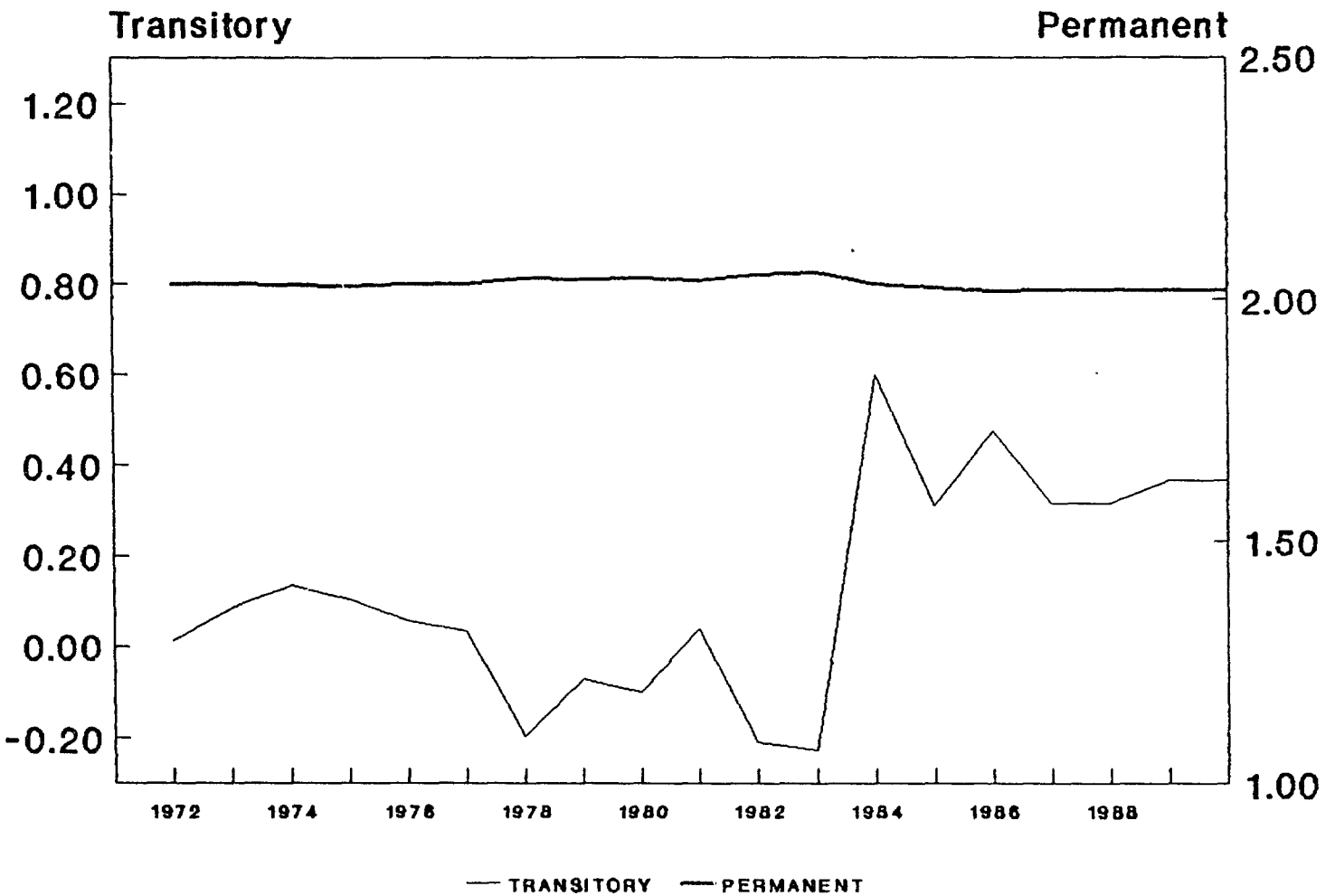
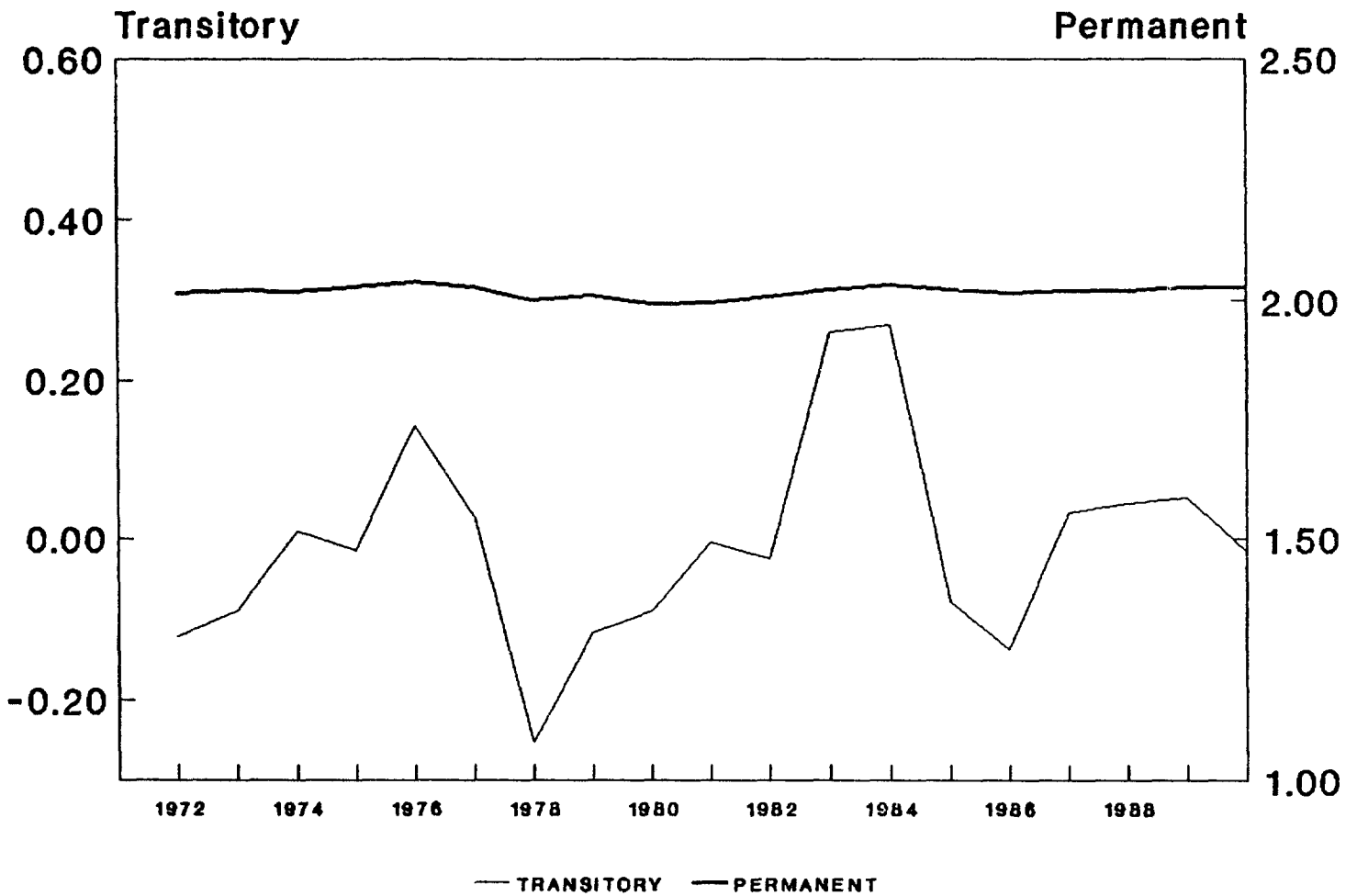
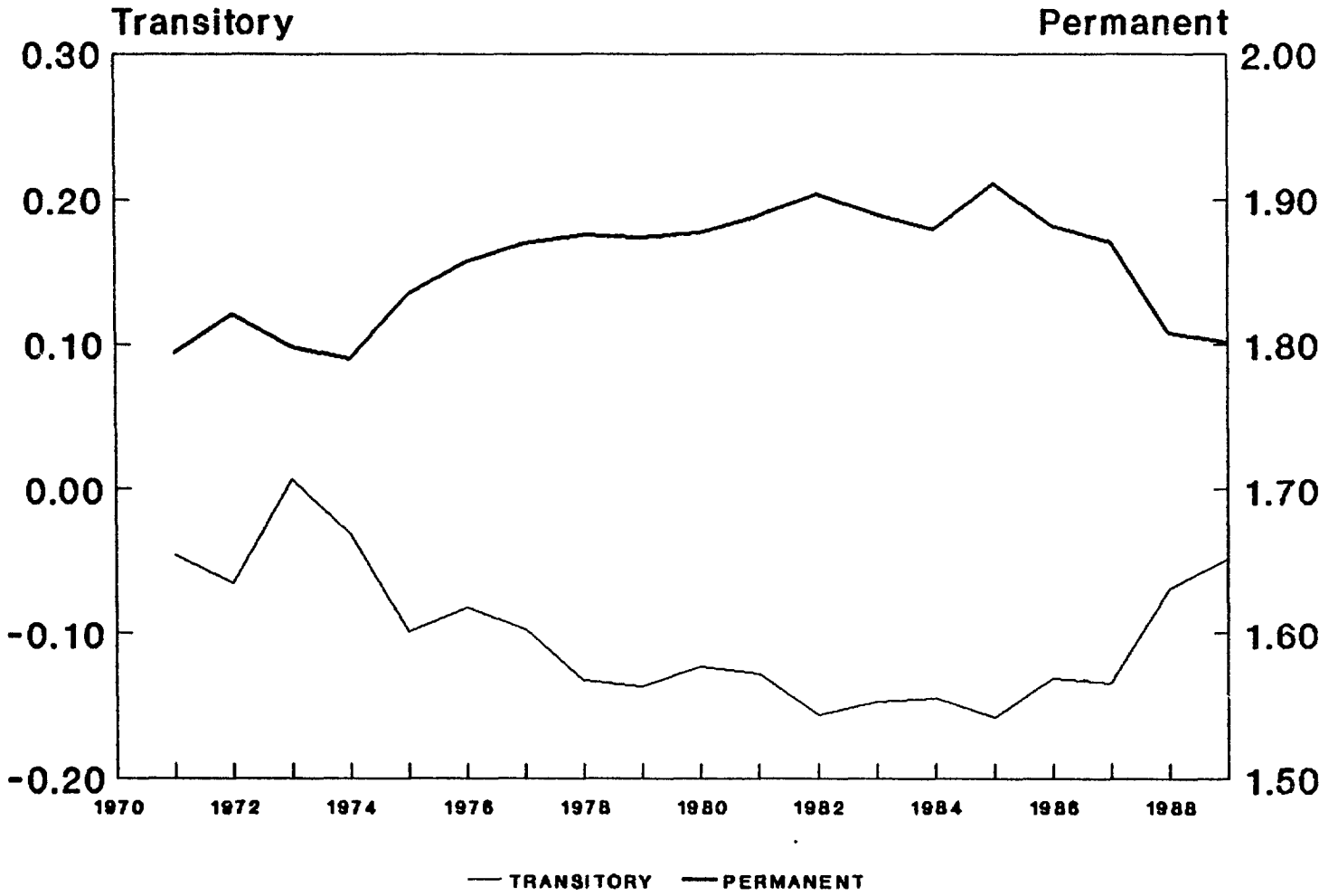


Figure A.1.5

# TAX ON IMPORTS



# Figure A.1.6
# DOMESTIC CREDIT



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